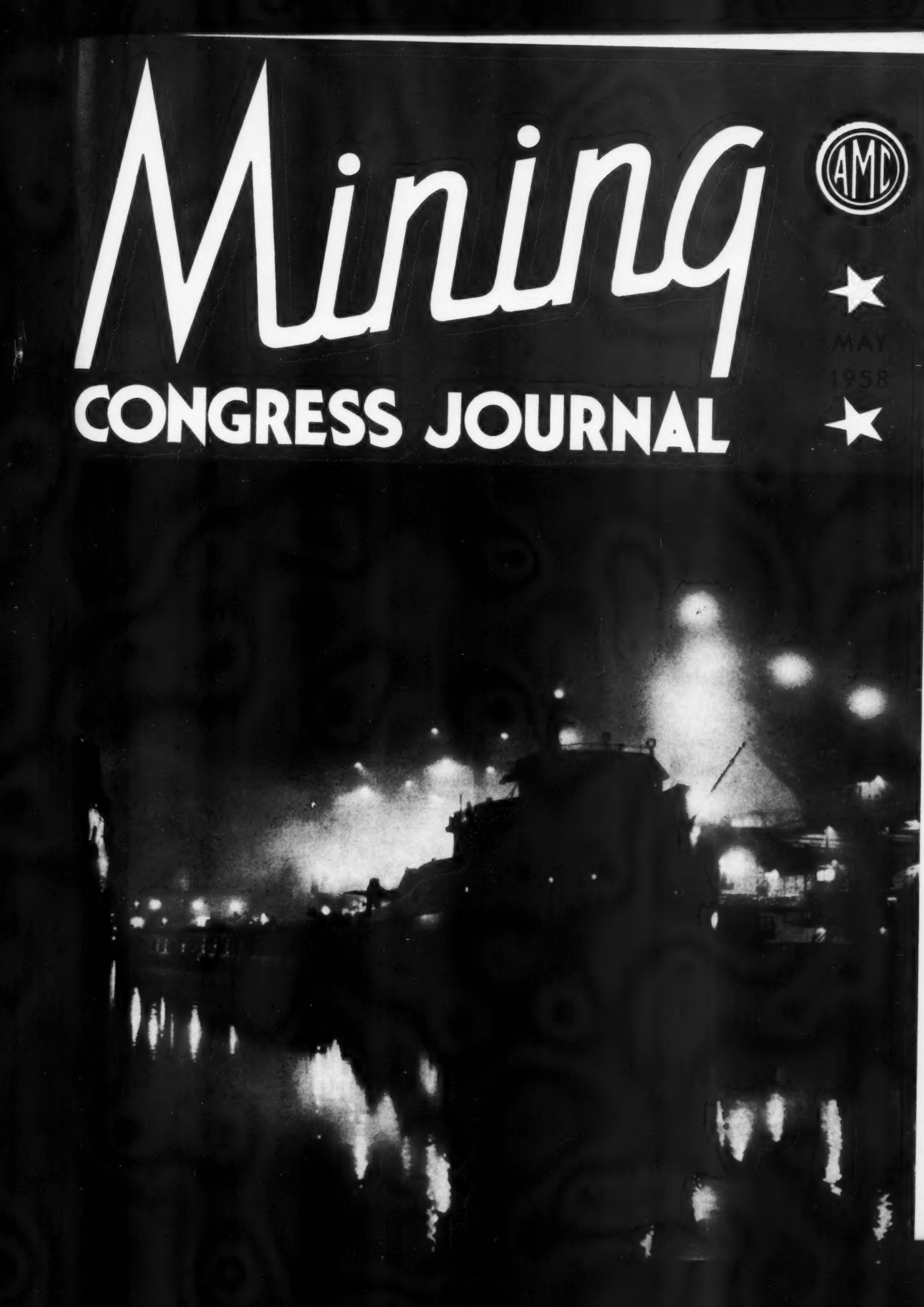
# Mining CONGRESS JOURNAL

MAY 1958



*Over 30 years of Progressive Engineering brings you*

*an* ***Improved*** **DENVER**

*Spiral Rake*

# THICKENER

## *Reduces Your Cost for Thickeners 15%*

The up-to-date design, materials and workmanship built into this DENVER Thickener provide trouble-free operation and highest efficiency at lowest cost in normal, standard, heavy duty and extra-heavy-duty service:

- Specially engineered, high strength worm gear provides maximum torque rating in all gear sizes. Runs in oil for friction-free operation.
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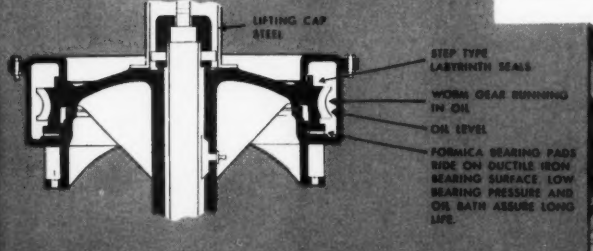
- Visual overload indicator and limit switch protect against overload damage.
- Integral manual, motorized or automatic-motorized lifting mechanism.
- Fully enclosed gear housing is weatherproofed for year around, outdoor service.
- Patented rake design brings settled solids to center discharge cone in one revolution, minimizes choke-up, assures continuous operation

You can count on DENVER Thickeners for high density underflow product, clear overflow, long, maintenance free service in thickening, clarification or water reclamation service. Completely automatic units and tray thickeners also available. Write for Bulletin T5-B5 or give us details of your thickening problem for complete comprehensive recommendation. Let us give you an estimate on your thickener tanks, whether steel or wood. Thickeners available in sizes to 150′.

**SIMPLE, RUGGED, LOW COST**
**Running-in-Oil Mechanism**

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Complete Mill Equipment

# Mining

MAY, 1958

VOLUME 44 NUMBER 5

## CONTENTS

## CONGRESS JOURNAL

FRONT COVER: Bethlehem Steel Corporation's carrier "Johnstown," enveloped in fog, unloads at the Lackawanna plant.

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ARTICLES

22 Diversification: Key to Growth of Anaconda — Murl H. Gidel
27 Two Seam Stripping and Parting Removal — Frank Gilbert
29 Human Failure—Sleeping Giant — George A. Borgeson
39 A Prediction of Future Demands in Coal Quality by the Electric Utility Industry — R. H. Wolin
43 Organization for Exploration — James P. Pollock
47 Rock Dusting in Multiple-Shift Operations — C. E. Linkous
51 Drill Steel Developments in the Laboratory — Floyd R. Anderson
54 Continuous Mining Productivity — R. L. Anderson
58 Steep Rock's Hogarth Shaft — Gerald B. Hamilton

DEPARTMENTS

21 Editorials
62 Operators' Corner
63 Wheels of Government
66 Personals
69 News and Views
81 Manufacturers Forum

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# Coal Chief scoops and dumps 100 tons a minute!

**Four Boom Support Strands**, each 3⅝" dia., support the huge boom which towers 160 feet above the ground. These Tiger Brand cables are designed for long service life.

**USS American Tiger Brand Hoist Rope.** Two of these 2⅝" dia. shovel hoist ropes supply the guts to lift the heaviest loads.

# Rigged with USS American Tiger Brand Wire Rope

**Here's the latest** of the big diggers, the Coal Chief, built by Marion Power Shovel Company. It can scoop up 70 cubic yards at a bite, swing it approximately the length of a football field and dump it in piles more than 96 feet high. It makes the round trip in less than 60 seconds.

This strip mining operation is a joint venture between Simco Peabody Company and Columbus & Southern Power, Columbus, Ohio. All the coal produced will be furnished to the power company . . . about 8,000 tons a day.

The new shovel, like its two predecessors, is rigged throughout with USS* American Tiger Brand Wire Rope. The tremendous power of the shovel is handled by two hoist ropes 2⅝" diameter, and the gigantic boom is supported by four lengths each 105½ feet long, of 3⅝" diameter galvanized boom support strand. Each strand has a catalog strength of 768 tons, for a total of 3,072 tons.

Your equipment may not need such large wire rope, but the fact that all applications on this huge shovel are handled by standard USS American Tiger Brand* constructions emphasizes the quality of the engineering that goes into the complete line of Tiger Brand Wire Rope. For more information, write American Steel & Wire, Rockefeller Building, Cleveland 13, Ohio.

**American Steel & Wire**
**Division of USS United States Steel**

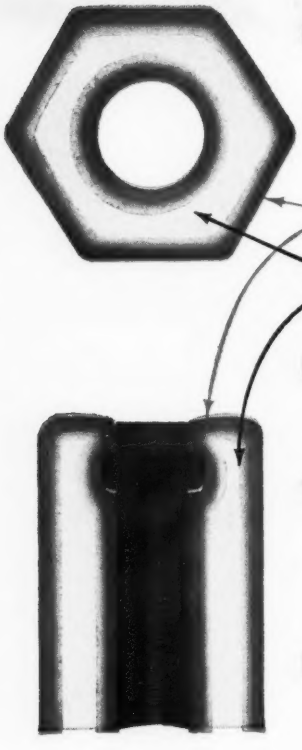
*TRADEMARK

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad

**6,000 tons** of overburden per hour can be stripped by this new 70-cubic-yard Marion shovel built for Simco Peabody Company and Columbus & Southern Power.

# GARDNER-DENVER DRILL STEEL

## Cuts drilling costs... reduces steel breakage



### Made like tough rock drill parts

Gardner-Denver sectional drill steel is carburized to produce the same hard case, soft core structure that produces superior rock drill parts. Shot-peening increases fatigue resistance.

High-tensile surface strength resists abrasion, corrosion, nicking and down-the-hole gaff.

Tough, soft core provides compressive strength to withstand shock loads without breaking.

### Made from quality steel

Gardner-Denver uses special alloy steels to insure uniform hardening and longer service life.

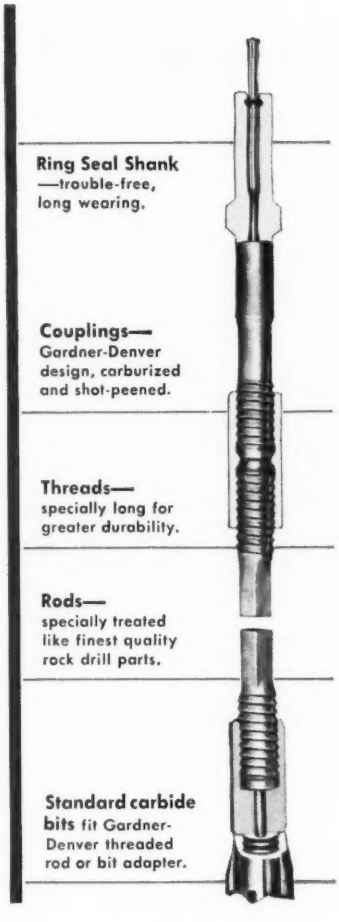
### Threads and couplings designed for the job

The extra long threads and couplings of Gardner-Denver design provide greater strength and durability. Couplings are also carburized to provide a hard surface on the threads and a tough core.

### Proved on the job

One user drilling hard rhyolite reports steel breakage reduced by 45% after changing over to Gardner-Denver drill steel.

Drill steel represents a large percentage of drilling costs. Gardner-Denver drill steel costs less to use. Write for information.


Ring Seal Shank —trouble-free, long wearing.
Couplings— Gardner-Denver design, carburized and shot-peened.
Threads— specially long for greater durability.
Rods— specially treated like finest quality rock drill parts.
Standard carbide bits fit Gardner-Denver threaded rod or bit adapter.

**Gardner-Denver Sectional Drill Rod Specifications**

| | CL5-200 Series | CL5-400 Series | CL5-600 Series | CL5-700 Series | CL5-1000 Series |
|---|---|---|---|---|---|
| Thread Size | 1 1/16" | 1 1/4" | 1 1/2" | 1 3/4" | 2 1/2" |
| Recommended Drill Size | 3" and smaller | 4" and smaller | 4" and 4 1/2" | 4" and 4 1/2" | 5 1/2" |
| Recommended Bit Size | 1 5/8" to 1 7/8" | 2" to 2 1/4" | 2 3/8" to 2 3/4" | 3" to 4" | 4", 4 1/2" and 5" |
| Rod Sizes | 7/8" Hex. | 1" Hex. | 1 1/4" Hex. | 1 1/4" and 1 1/2" Hex. | 1 7/8" Hex. |
| Rod Lengths | 2' to 20' | 2' to 20' | 2' to 20' | 2' to 20' | 4' to 20' |
| Coupling Diameter | 1 7/16" | 1 3/4" | 2 1/8" | 2 1/2" | 3 3/8" |
| Ring Seal Shank | 1" Hex. Collared<br>1 1/4" Rd. Lugged | 1 1/4" Rd. Lugged<br>1 1/2" Rd. Lugged | 1 1/4" Rd. Lugged<br>1 1/2" Rd. Lugged | 1 1/2" Round | 2 1/2" Round |

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IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

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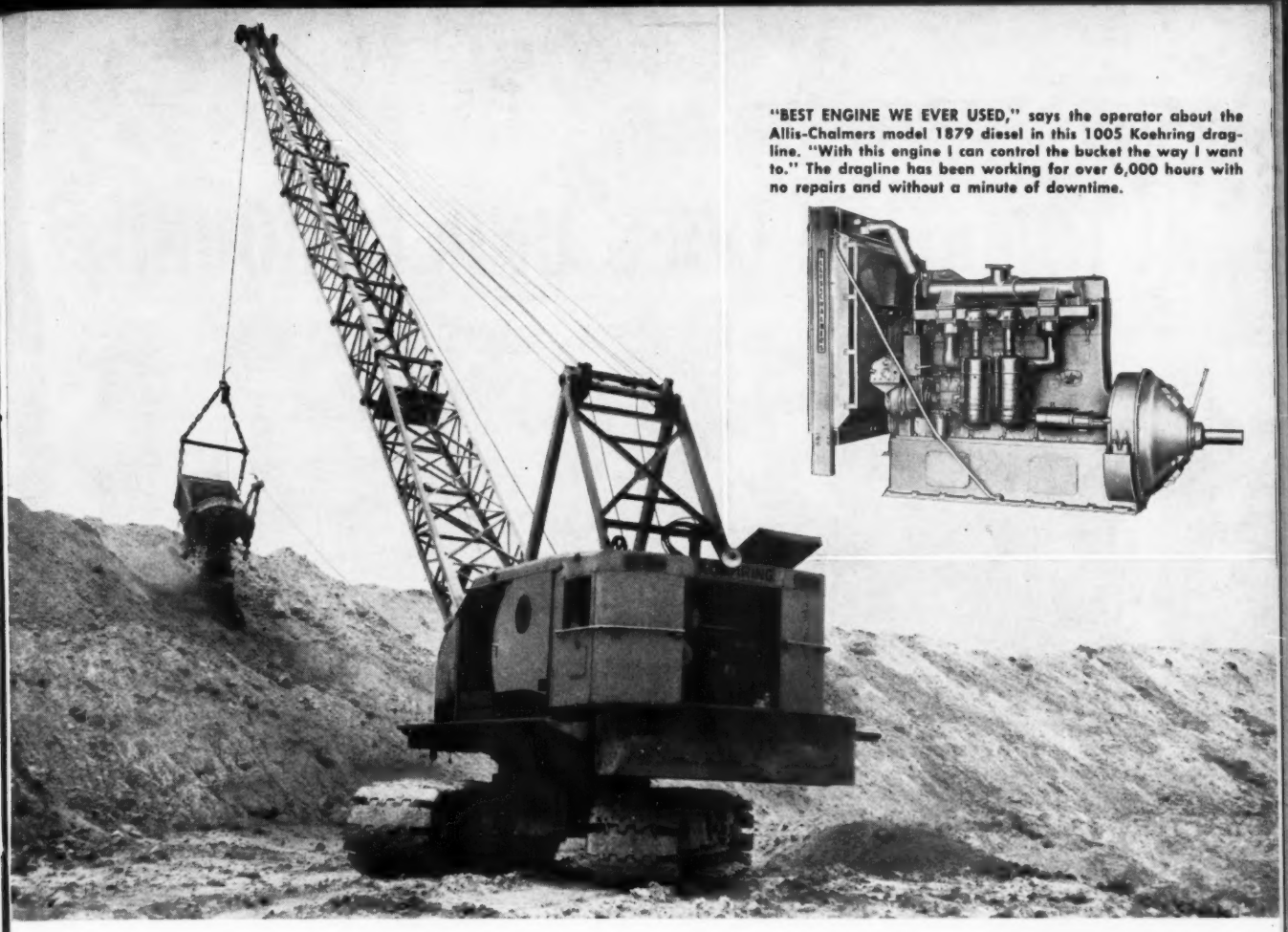


**"BEST ENGINE WE EVER USED,"** says the operator about the Allis-Chalmers model 1879 diesel in this 1005 Koehring dragline. "With this engine I can control the bucket the way I want to." The dragline has been working for over 6,000 hours with no repairs and without a minute of downtime.



## Allis-Chalmers Engines give you DO MORE POWER

## That's RIGHT for your needs

**RIGHT PERFORMANCE** — Allis-Chalmers engines have *Do-More Power*—high torque, maximum work for each operating dollar.

**RIGHT TYPE AND SIZE** — There's a wide range of sizes and types, 9 to 516 hp — benefit from *Do-More Power* in *all* your equipment.

**RIGHT FUEL** — You can choose the fuel that's most practical — diesel, LP or natural gas or gasoline.

**RIGHT SERVICE BACKING** — wherever you are. Your Allis-Chalmers engine dealer has stocks of parts, backed by nearby company branch stocks. He also has factory-trained servicemen — complete facilities to give you prompt service.

See your Allis-Chalmers dealer for full details on *Do-More Power* engines that are right in every way for your job. Allis-Chalmers, Engine-Material Handling Division, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS**

BC-11

US RUBBER CONVEYOR BELTING

# AUTOMATION GOES UNDERGROUND

## "U. S." Belts help make a push-button conveyor system foolproof

Automation is spreading day by day in the coal mines. For example, in the Dana Slope Mine of the Amherst Coal Co. (Rensford, West Va.), the conveyor system, equipped with U.S. Rubber Belts, operates entirely by push button. The limited storage capacity, both inside the mine and on the surface, makes it mandatory that the slope conveyor operate without interruptions. Any stoppage would quickly tie up the mine and stop production.

Obviously, an automatic conveyor system is only as good as the belting it uses. That's why Amherst selected "U.S." The reputation of "U.S." Belts for dependability and long-life economy was Amherst's best guarantee of trouble-free coal-handling. And their judgment has been proven correct.

This 986-ft. slope belt, for instance, is a 42" U.S. Giant® 6-ply YN belt, operating at a 16-degree incline. Installed in 1952, it has given a trouble-free service and is outstanding in troughability, training and resistance to abrasion, shock, cutting and gouging. It is expected to last many years.

A complete line of U.S. Belting, to handle any materials-handling problem, is available at your local "U.S." Distributor, or write us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

US RUBBER

Mechanical Goods Division

**United States Rubber**

See things you never saw before. Visit U. S. Rubber's New Exhibit Hall, Rockefeller Center, N.Y.

North...south...east...or west...

# pit owners cut costs with rugged pivot-steer haulers

From Georgia to Wisconsin... from Virginia to California... pit owners are operating under widely varying job and weather conditions. But there's one thing all pits shown have in common... the type hauler they bank on to cut pit costs. It is the rugged LeTourneau-Westinghouse Tournapull® Rear-Dump.

Wherever they operate, these machines dump clean and fast... clear over banks, or into hopper. Front-wheel drive holds Rear-Dump steady and safe at soft bank-edge. Units have big, wide, all-steel bodies for fast loading and low maintenance. And, go-anywhere 'Pulls* haul through mud or slippery going where conventional haulers would have to call it "quits."

Read these owner-verified reports... then give us a call. We'll be happy to show you how these electric-control Tournapull Rear-Dumps can fit into *your* operations to help *you* cut pit costs. Three sizes: 11, 22, and 35 tons; with 138, 210, 300 or 335 hp diesel engines.

N

**Wisconsin gravel pit** — In an effort to step-up production and cut hauler maintenance expense, this large gravel pit replaced a fleet of trucks with 3 Tournapull Rear-Dumps — 2 "D's" and a "C". Says pit superintendent, "Most truck bodies are too thin. Our work is also too hard on truck tires, transmissions, differentials, springs, and drive shafts. These rugged L-W units outlast ordinary haul trucks 10 to 1."

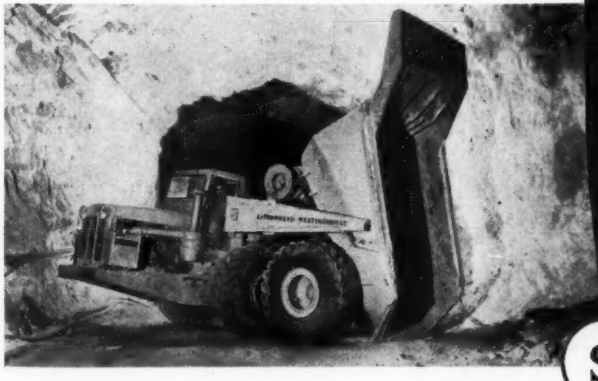
**Virginia limestone pit** — 3 D Rear-Dumps replace 10 trucks... together, haul 1000 tons of rock to crusher per 8½-hr day. Comments owner, "We went through $56,000 worth of trucks in 5 years before we switched to Tournapull Rear-Dumps. These machines are the only thing for hauling rock. Trucks just can't compare." Says operator, "They're as simple to run as a car. I like 'em fine!"

W

E

**California quarry** — Tough underground tunneling operations required a rugged hauler that could maneuver in extremely cramped quarters, haul over narrow, winding roads. Pit owner's choice — 3 C Tournapulls with 22-ton Rear-Dumps. Unit is shown making continuous 180° turn (with body in dump position) in area just 20'8" wide. Electric controls also contributed to ease of operation and safety.

**Georgia kaolin pit** — Despite wet, slippery roads, 2 D Tournapulls with 11-ton Rear-Dumps haul sand and red clay overburden 500' to dump in 1 min 24 sec. With electric-hoist, bowl can be lifted for full, instant dump, or held at any angle for slow, precision feeding into hopper. Mine superintendent likes 'em, "cause they're easy to maneuver... pull themselves easily out of soft footing."



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*Trademark R-1836-MQJ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

*A Subsidiary of Westinghouse Air Brake Company*

**Where quality is a habit**

# BUILT FOR BOULDER BUSTING BRUTES

Stop breakage problems on every kind of earthmoving job with tough, rugged *ESCO* Cast 12M Dozer Cutting Edges. *ESCO* Cast 12M Cutting Edges can take the severe punishment of longer pushes and rougher pioneering, even on the largest machines.

Careful heat treating of this *ESCO* steel alloy, 12M, makes *ESCO* Cutting Edges extra tough and hard *all the way through.* And, the same qualities that insure this breakage resistant toughness also impart amazingly high wear resistance.

You've really got the edge for low cost earthmoving and pioneering with *ESCO* Cast 12M Dozer Cutting Edges. Call your nearest *ESCO* dealer today for details.

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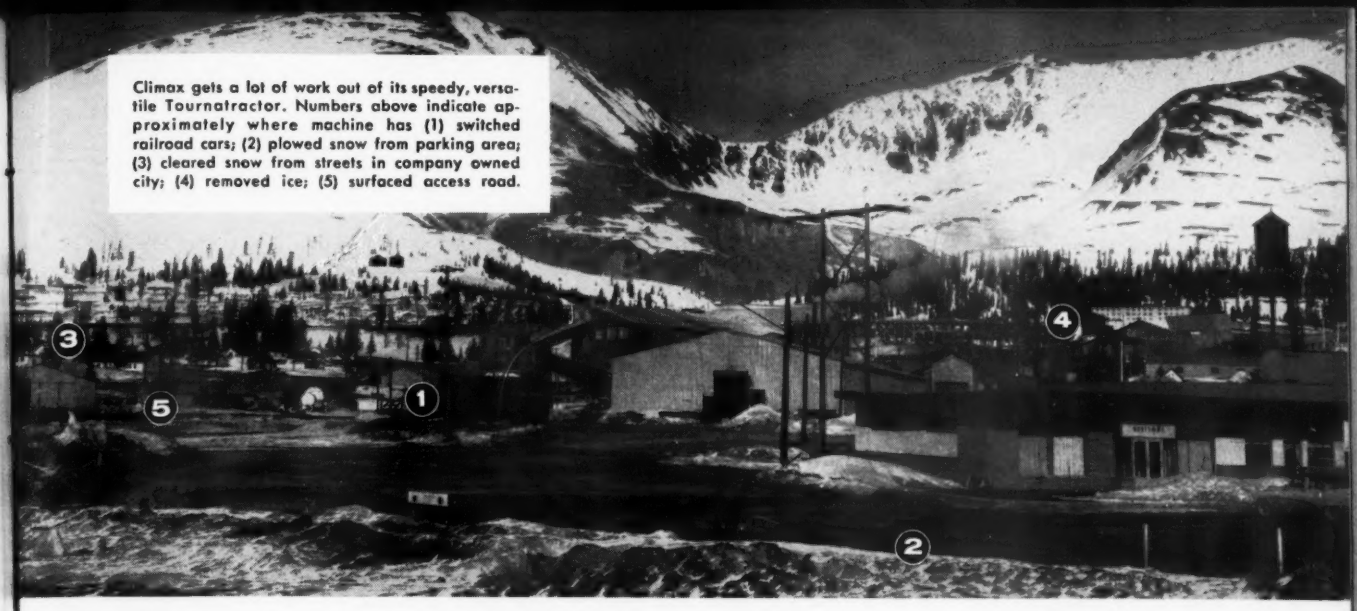



Climax gets a lot of work out of its speedy, versatile Tournatractor. Numbers above indicate approximately where machine has (1) switched railroad cars; (2) plowed snow from parking area; (3) cleared snow from streets in company owned city; (4) removed ice; (5) surfaced access road.

# Why Climax Molybdenum Company switched to tractor-on-rubber at world's largest underground mine

High up on the Continental Divide in the Colorado Rockies, Climax Molybdenum Co. operates the world's largest underground mine. Its mountainside location — 11,320′ above sea level — offers a tough test for the tractors Climax uses to maintain 22 miles of roads, and to service 150 acres of mine and surrounding area. Temperatures occasionally dip to 35° below zero; snowfall last winter measured over 30 feet.

Fastest, most powerful tractor in the Climax fleet is a LeTourneau-Westinghouse Tournatractor®, purchased in 1954 to replace a big crawler unit. The reason Climax switched to this speedy 210 hp rubber-tired tractor is explained by Supt. Burton Baumann:

"The snow and ice here make crawler upkeep just too expensive," he says. "A set of tracks lasts only 9 months. So we bought this rubber-tired Tournatractor to have a rig that would end that problem — that could work in snow without getting stuck, and would be dependable."

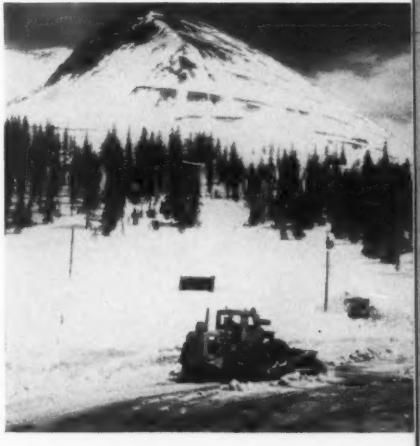
Tournatractor has met those requirements completely. After 3 years of service . . . during which time it has built and surfaced roads, worked on a tailings-pond dam, removed ice, switched railroad cars, and done a tremendous amount of snowplowing . . . Climax men say these things about it:

**Supt. Baumann:** "We *like* the tires as compared to crawlers. We used chains the first year, haven't used them since. Tournatractor can handle 95% of our tractor work, and its maintenance record has been excellent. Actually, with our preventive maintenance program — we try to catch little things before they become major problems — after 3 years, we still have had nearly 100% availability of our Tournatractor."

**Ass't. Ray Lykins:** "Tournatractor will plow as much snow as 3 crawlers, and leave the area clean. It's as fast as our truck plow, too. And on job-to-job travel, it takes only about 20 minutes to cover a distance that would take at least 45 minutes with a crawler. Cold weather starts are no problem at all."

**Operator Bob Flowers:** "It's a much easier-riding machine than a crawler — doesn't have near the jar. It's faster and easier to control. The cab is really warm, even in below zero temperature. Tournatractor is *very* easy to operate!"

***Call or write for details on how 17 mph, 210 hp Tournatractor can solve varied tractor problems on your mining and exploration operations. No obligation.***



During month of May — high up on mountainside Tournatractor clears remains of winter's 30′ snow at Climax Molybdenum mine, Climax, Colorado. This big, rubber-tired workhorse "clears as much snow as 3 crawlers" according to mine officials. CT-1599-MJ-1

**LeTourneau-WESTINGHOUSE Company,** PEORIA, ILLINOIS

*A Subsidiary of Westinghouse Air Brake Company*

WHERE QUALITY IS A HABIT

# How to get longer service life with Whyte Strand Mining Ropes

You can lengthen the service life — and lower the yearly cost—of your wire ropes by using the *correct* Whyte Strand Wire Rope for each application.

What do we mean by correct? Well — all wire rope isn't alike. The demands of dragline service are different from those on haulage ways or shaft hoisting. And there's a Whyte Strand rope specially designed to withstand the particular abuses of *each* kind of mining service. What's more, we'll be more than glad to work with you in finding which of Macwhyte's thousand-and-one ropes is the *best* for *your* kind of job.

All Macwhyte ropes are Internally Lubricated, by a special process which individually coats every wire . . . every strand . . . with a tough, tenacious lubricant coating. This increases the rope's flexibility, reduces internal wear, and provides excellent corrosion resistance. Result: Longer service life with Whyte Strand Mining Rope.

Ask your Macwhyte distributor to give you the correct wire rope specifications for use on *all* your equipment!



*Write for industry's authoritative booklet on wire rope and its uses. Ask for Catalog G-16 — the Blue Book of Wire Rope!*

MACWHYTE Wire Rope COMPANY

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Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel, Plastic Coated and Nylon Coated Wire Rope, and Wire Rope Assemblies. Special catalogs available.

109

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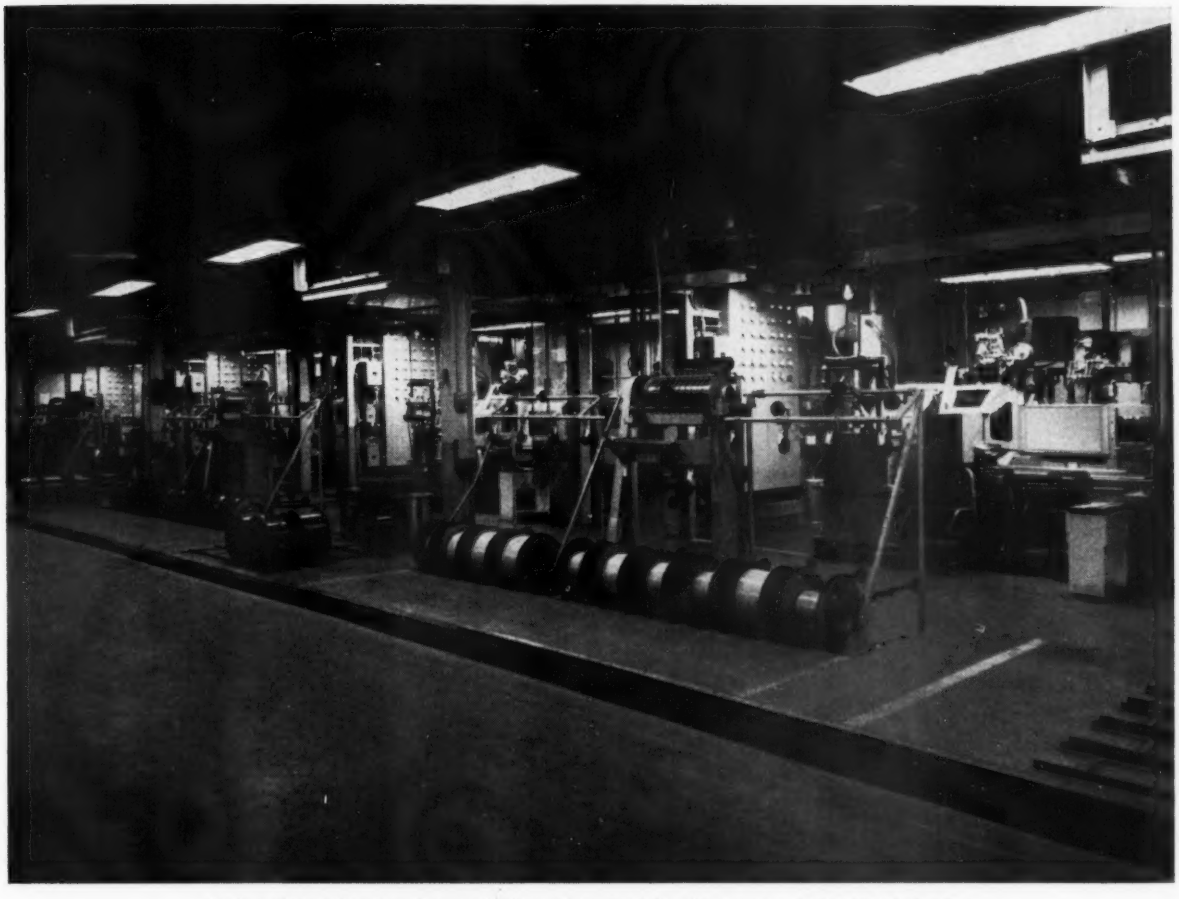


A view of the fully automatic assembly line at Pompton Lakes, N. J., where Du Pont Electric Blasting Caps, both regular and delay, are completely assembled by electronically-operated machinery.

# Du Pont announces the first 100% mechanically assembled electric blasting caps

## to assure you even more uniform, more reliable products

Here, in the only factory of its kind, Du Pont Electric Blasting Caps are now made on fully automatic machinery to give you the utmost in reliability, uniformity, and dependability.

Every step in the process, from automatically loading the shell (and inspecting it 3 times during loading alone), to applying the shielded shunt and paper band is electronically controlled.

This revolutionary approach means that every Du Pont Electric Blasting Cap—regular or delay—*must* meet our rigid standards at *every step* or it will be automatically rejected by one of the dozens of electronically controlled "watchmen."

This elimination of the human equation means that all Du Pont Electric Blasting Caps are even more uniform, more reliable, more dependable than ever before.

And you get all these benefits at NO INCREASE IN COST. Call your Du Pont representative or write to E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

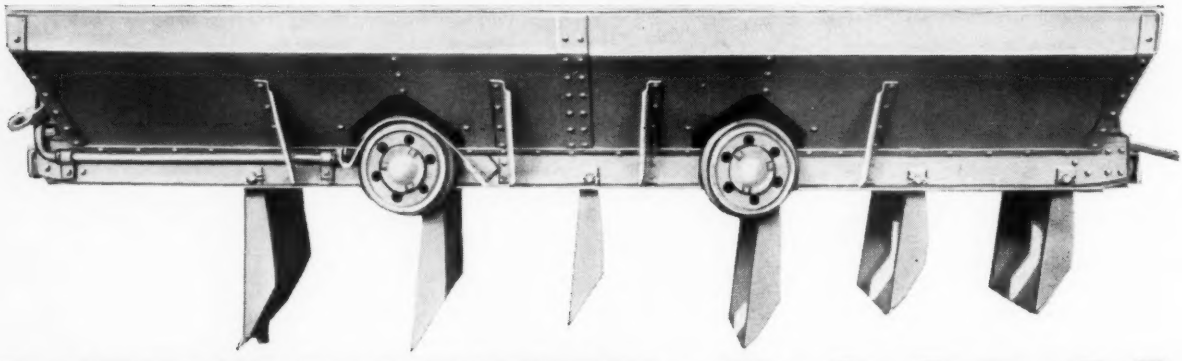
**DU PONT BLASTING CAPS**

*Products of Du Pont Research*

DU PONT
REG. U.S. PAT. OFF.

**BETTER THINGS FOR BETTER LIVING**
***. . . THROUGH CHEMISTRY***

# only acf automatic drop bottom cars have



# LUBRICATED DOORS!

- **Smoother, faster operation**
- **Minimum wear, year after year**
- **Speedy unloading with easy, positive door action**
- **Corrosion resistant hinge rods**
- **Interior fittings for greasing**

acf Automatic Drop Bottom Mine Cars are available in every capacity and type. Designed and constructed to meet specific operating needs. Welded end sill members, exclusive double action spring bumpers. Chilled Tread "Load Support" Wheels with roller bearings assure long, trouble-free service.

For complete information, contact your nearest acf sales office.

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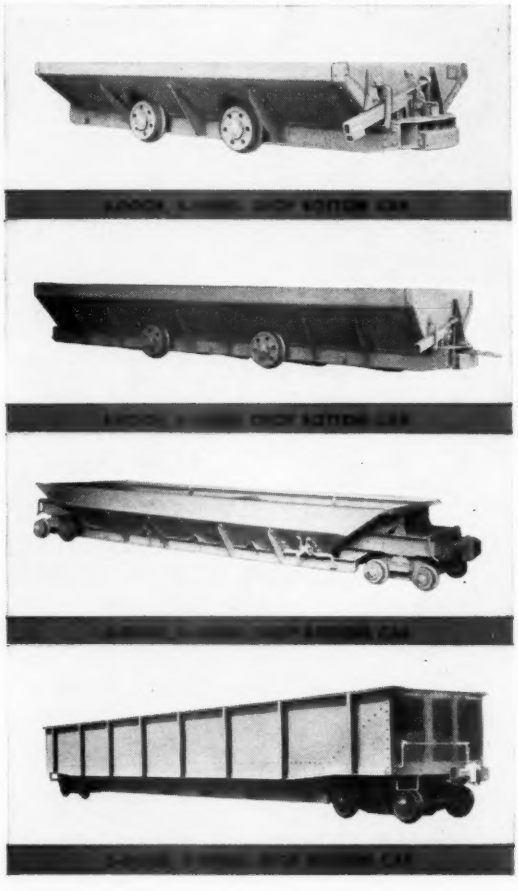
Sales Offices: New York–Chicago–Cleveland–Washington, D.C.–Philadelphia–San Francisco–St. Louis–Berwick, Pa.–Huntington, W. Va.



*Bulletin describing all types of* acf Mine Cars *available on request.*

acf

**AMERICAN CAR AND FOUNDRY**

DIVISION OF ACF INDUSTRIES, INCORPORATED

***MINE CARS FOR CONSTANT HAULAGE.***

# Uncovering Pure White Kaolin Clay

One of the many uses for large-size Marion excavators is illustrated by this Type 7400 walking dragline which removes overburden averaging 62 feet in depth at a kaolin clay mine in Georgia. The big walker is equipped with a 220-foot boom and a 9-yard bucket. Kaolin clay is a vital ingredient in the products of the rubber, glass, paper and ceramics industries.

This 43-M maintains a steady flow of raw material for large Ohio brick and tile plant. Heavy-duty construction of the 1-yard shovel matches that of larger Marions. There's a machine in the extensive Marion line that's just right for your job, too.

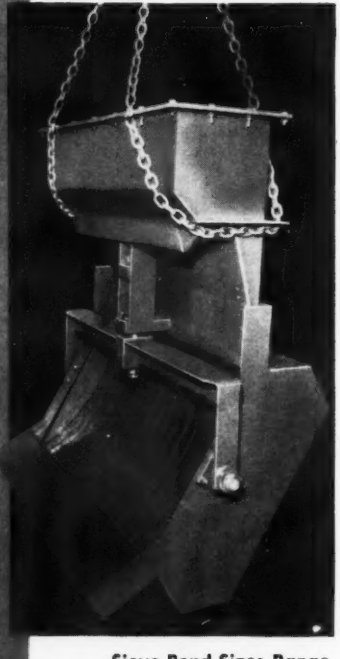
***CONSULT*** **MARION** ***MINING SPECIALISTS***
***for lowest costs on your property!***

**MARION POWER SHOVEL COMPANY—MARION, OHIO, U. S. A.**

*A Division of Universal Marion Corporation*

*Another*
*Heyl & Patterson Service to the Coal Industry...*

**We Have Been Granted the Exclusive Distributing and Manufacturing Rights to the DUTCH STATE MINES SIEVE BEND for Most Applications in the American Coal Industry**



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It's so simple— when you need a pump *Call*

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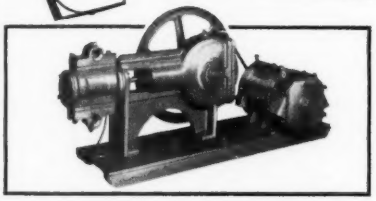

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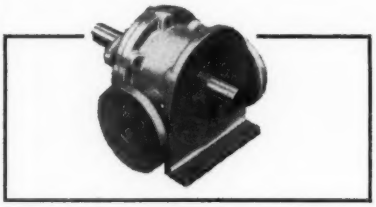

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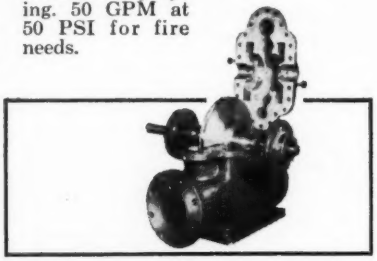

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**PUMP REPLACEMENT PARTS** for practically all types and makes of centrifugal and plunger pumps.

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## for the very finest in Conveyor Chain

*Here's why...*

*Clarkson Redbird* has the *welded* flight assembly that ends once and for all any need for adjustment, lessens wear and strain, eliminates stripped and corroded threads, loosened and lost nuts. *Clarkson Redbird* Conveyor Chain is shipped in assembled sections—no need to bolt flights to chain piece-by-piece . . . just join two or three sections to make a complete chain, ready for your hardest service. Ask us for the many supporting reasons for *Clarkson Redbird* leadership in conveyor chain performance—today!

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# SHHH!
# he's listening to a cable fault!

## *with the O-B Fault Locator*

Because they're so hard to find, hidden cable faults often cause more lost production, more wasted man hours — more wasted cable, in fact — than the big faults that rupture insulation and actually destroy cable. That's why you'll find more and more mine properties today investing in O-B Cable Fault Locators, in many cases using as many as 10 Locators on a single property!

Powerful, compact (you can carry it in your pockets), rugged and virtually "tamper-proof," the O-B Locator pinpoints in a matter of minutes cable faults that would ordinarily take hours to find. The complete unit weighs only four pounds and consists of just four elements: battery and signal generator (being attached to cable end below), and headphones and slim transistor receiver. The latter, as shown above, are the only parts carried along the cable during testing! Takes only minutes to set up, tests cable up to 600 feet or longer, costs less than any cable you'll use it on! Write for complete information, or order Catalog No. 22567 to try it out for yourself.

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## —And Anaconda's flat 50% Grounding Wire offers full electrical protection with small diameter!

To get full electrical safety protection it is necessary to have a full 50% grounding wire. Anaconda Shuttle Car Cable gives you that—and much more!

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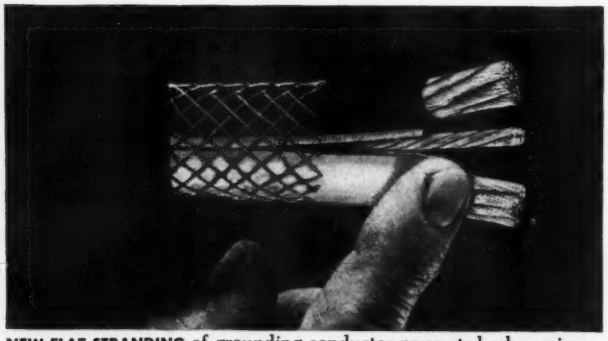

**NEW FLAT STRANDING** of grounding conductor prevents broken wires—assures continuity of operation. Full 50% wire delivers maximum electrical protection.

Millions of feet of Anaconda Shuttle Car Cable have been sold without a single reported failure of grounding conductor.

The flatness of Anaconda's cable is important, too: better reeling, more cable on a reel!

**4 REASONS WHY ANACONDA IS THE MOST ECONOMICAL CABLE YOU CAN BUY!**

**1.** The only cable with rugged high-grade *neoprene insulation* that greatly increases resistance to puncture, flame and crushing.

**2.** Patented nylon breaker strip that reduces short circuits.

**3.** Improved stranding of ground and power conductors that increases flexibility and prevents broken wires.

**4.** Nylon seine twine jacket reinforcement prevents wicking of moisture, gives jacket greater tear resistance.

The Man from Anaconda or your Anaconda distributor will be glad to give you full information. See him today. Or write: Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.

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SEE THE MAN FROM **ANACONDA®**

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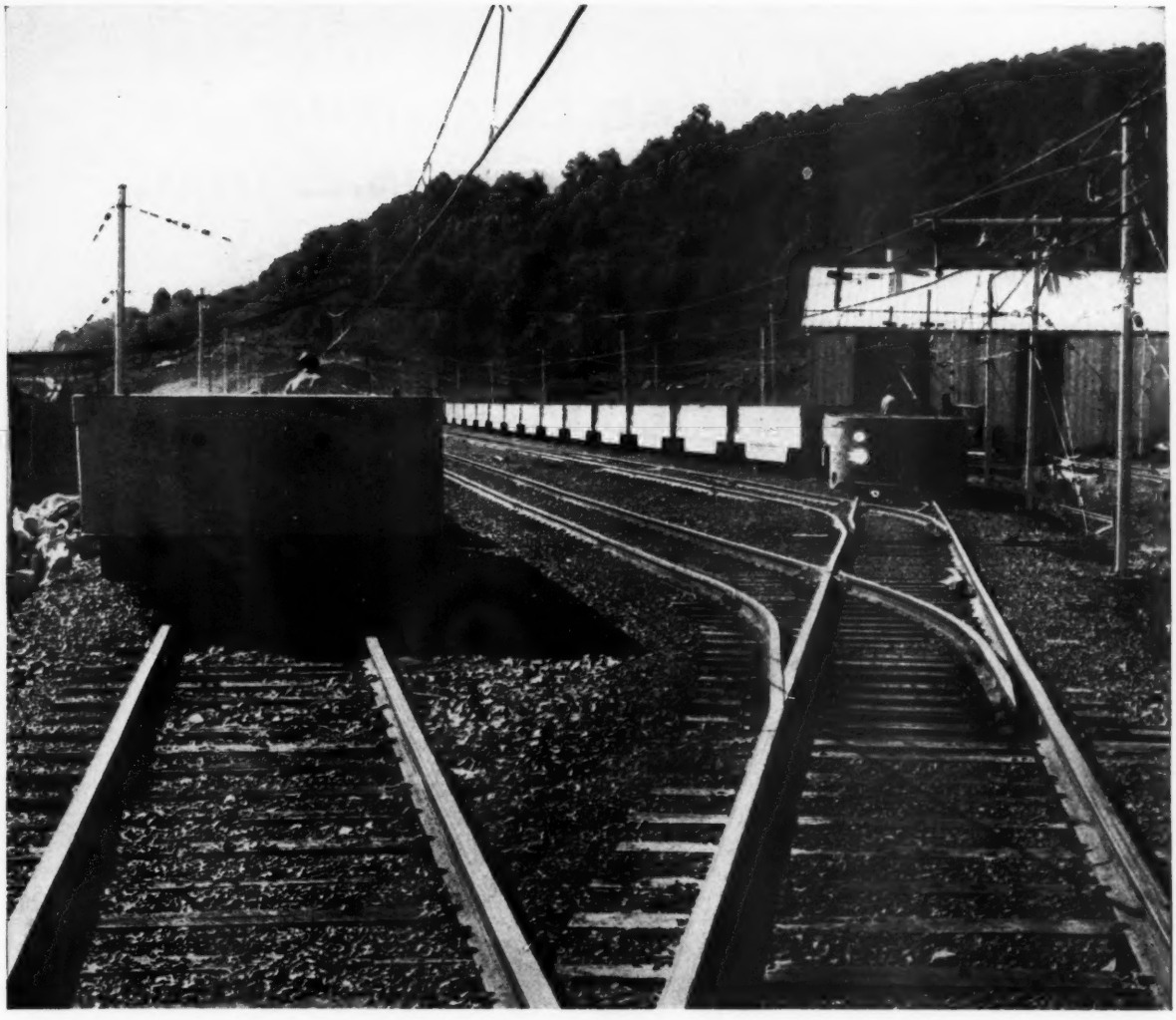

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One glance tells you this ladder track is something special. And that's the very point we want to make: *all* Bethlehem mine-haulage trackwork is especially prefabricated to meet the specific needs of the mine.

Let's say you need a ladder-track like this to open up a bottleneck that's hampered your operations. You simply turn the matter over to Bethlehem engineers, and let them work out the best possible design. The first thing they'll do is make a thorough check of the operating routine. Then they'll go into a huddle with specialists here in Bethlehem, who in turn will design the trackwork to fill the bill.

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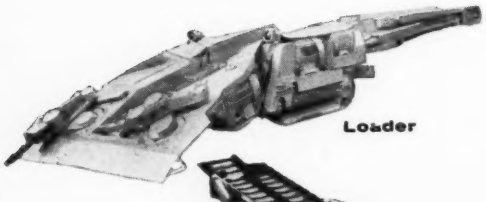
Production goes up with Jeffrey machinery in your mine. Maintenance is low. The reason . . . 80 years of world-wide experience applied to the development of mining and materials-handling equipment.



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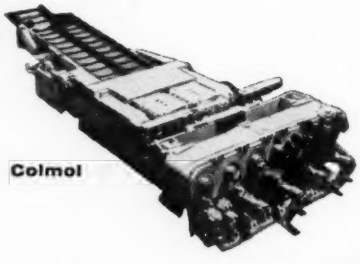

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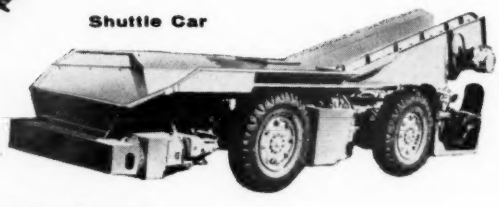
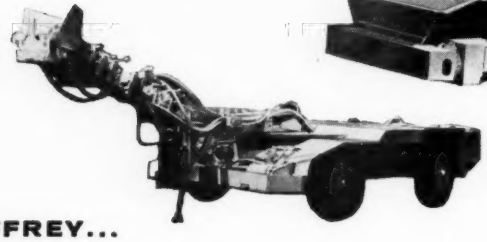


Shuttle Car



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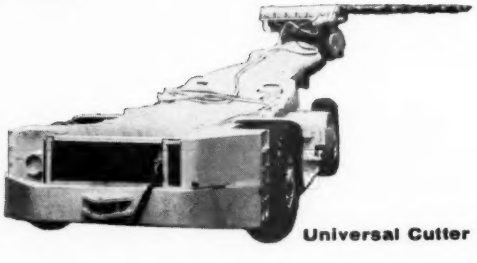
**SHUTTLE CARS**, matched to your mining height, to insure maximum loads.

**ROOF AND FACE DRILLS** to increase speed and safety of these operations.

**UNIVERSAL CUTTERS** to handle any kind of cut, any place in the seam.



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# EDITORIALS

ROBERT W. VAN EVERA, Editor

MAY, 1958

## FIRST AID AFTER SHIFT

Much has been accomplished in recent years by mine management, labor, machinery manufacturers, State and Federal agencies and others to better the mining industry's safety record. A particular phase of this work—a phase in which the mining industry leads all others—is the teaching of first aid to personnel. Contests and other devices, designed to encourage competition, have helped to keep interest high.

We are now entering into the 1958 season of first aid and mine rescue competition. MINING CONGRESS JOURNAL wishes complete success for each of these contests and urges full participation by the industry.

No one questions the value of first aid training, especially a man who has been involved in an accident in the mine, preparation plant, mill, or smelter! Many miners owe their lives to skilled first aid men who knew what to do at the right time.

But does the value of this first aid training stop at the end of the shift? Of course not. If a man can apply a tourniquet or give artificial respiration under the trying conditions of a mining operation, he can certainly use first aid principles at home, on the highway or wherever his skills are needed.

An excellent example of this took place last year in West Virginia. After attending a first aid contest, the Prenter Team of North American Coal and Dock Co. chanced upon a serious highway accident as they were driving home. Putting their skill to use, they dressed the injured and accompanied them to a nearby hospital.

This episode provides much food for thought. Men trained in the art of first aid are a definite asset to any community, and their talent should be recognized and utilized to a greater extent. For example, consider how much more valuable these men would be if their skill could be mobilized during a local disaster or emergency. Cooperating with local officials, they could ease the load of doctors who are often overtaxed during emergencies, and bring help sooner to those in need.

The possibilities are tremendous.

## SPEAK OUT

A great deal of interest has been shown in the article, "Communications—a Job for Top Management" by Robert A. Harper, which appeared in the April issue of MINING CONGRESS JOURNAL.

In it the author made a strong case in favor of using corporation employe publications to forcefully point out the management side of controversial labor matters—matters which are so effectively editorialized from the union point of view in official labor union publications.

True, the JOURNAL, as well as other magazines read by enlightened managers, publicizes and firmly believes in the management viewpoint, but obviously cannot reach the many thousands of workers in the industry. On the other hand, these wage-earners literally digest their company's house organs from cover to cover.

Harper, who made a detailed study comparing the seven most widely circulated union publications with some thirty-seven employe publications of the largest American corporations, singled out one company that is doing by far the best job of presenting what it believes is right, without pulling any punches. This was General Electric Company. And Harper observed that he "hadn't noticed that G.E. is suffering from union persecution because of it."

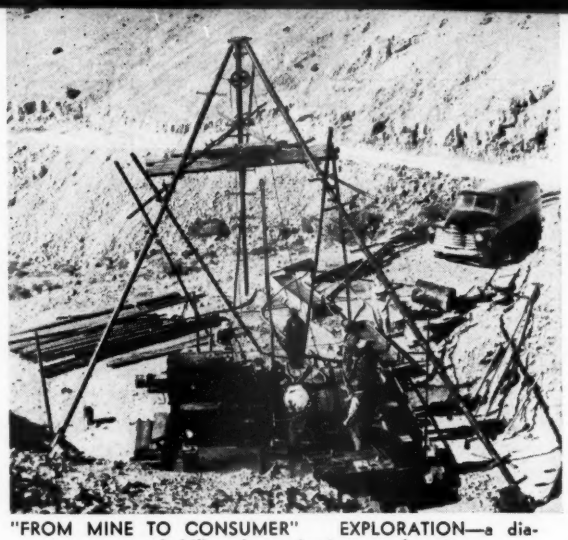
Now, months since the article was written, we read on the front page of *Wall Street Journal* (April 10, 1958) the following:

"General Electric prepares to flex its corporate muscle in the political arena.

"Unlike most large corporations which seek to maintain a delicate balance on the political tight-rope, G. E. plans to take sides on all major issues affecting business and 'the public interest.' Reason: Officials believe that the company, as well as its employes, has a stake in the many issues decided by governments at the local, State and Federal levels. . . . A promise: 'We intend to speak out on every major issue where we feel we can make a contribution,' states an official."

The men responsible for these policies at General Electric deserve a salute. Their determination to communicate the company's views—whether to employes or to government officials—sets an example that might be followed advantageously by many other corporations.

Since 1883 Anaconda has constantly and successfully developed new enterprises to meet increasing demands for nonferrous products



"FROM MINE TO CONSUMER" EXPLORATION—a diamond drill probes a foreign ore deposit

# DIVERSIFICATION

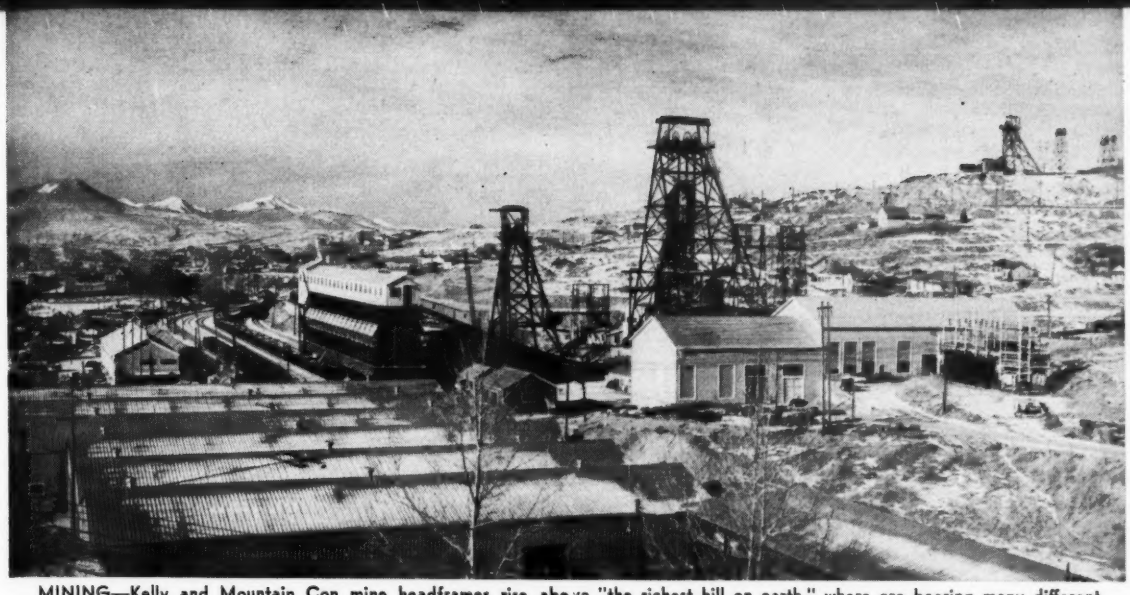
# key to growth of Anaconda

By MURL H. GIDEL

**Few people are as well qualified to review the history of The Anaconda Co. as Murl H. Gidel. He not only received his geology and mining engineering training in the Butte District at the Montana School of Mines, but has been employed continuously by Anaconda since his graduation in 1912. His work has led him to several mines in western states and on examinations of numerous properties in North America, and even as far as the Silesian-American Corporation's holdings in Poland. Gidel was promoted to assistant chief geologist in 1936. Recently Gidel retired from Anaconda, but he has continued his residence in Butte.**

THE history of the development and expansion of The Anaconda Company's operations in North and South America presents a fantastic story, all revolving around the aggressiveness of its entire past and present organization in promoting diversification of interests not only in the production of the more important metals such as copper, zinc, lead, manganese, molybdenum, aluminum, and uranium, but also of accessory elements such as the precious and other metals occurring therewith and sulphur, phosphate, arsenic, vanadium and selenium. Also during the period of World War II the company took over from Government agencies the major projects of development and production of magnesium and chromite to aid in the country's war efforts.

The history of the successful development and growth of Anaconda in its varied operations, principally on the Western Continents, has been centered around persistent expansion and diversification of its mining and metallurgical activities that were developed as a result of constant technological investigations and the solution of problems related thereto. This story has been told in a most interesting book entitled "Anaconda" recently written by Isaac F. Marcosson, which is comprehensive and contains a wealth of factual information about the development of the company from its inception in the early 1880's to the present time. This book is an excellent abstract of Anaconda's activities which has made it helpful to me in gleaning highlights relative to the subject of this article. C. F. Kelley, the late chairman of the board, sponsored the slogan "Anaconda Is Building," which has embodied a program to increase the company's production of nonferrous metals requiring large in-



MINING—Kelly and Mountain Con mine headframes rise above "the richest hill on earth," where ore bearing many different values is mined from the surface to more than 5000 ft underground, using methods ranging from block caving to square set

vestments for expansion of mining and reduction facilities, modernization and improvement of older plants, and salvaging mineral by-products whenever possible.

The growth of Anaconda has been phenomenal since the early days of gold-silver mining in the Butte District, the first company being incorporated in 1883 as the Anaconda Gold and Silver Mining Co., followed by The Anaconda Mining Co. from January 1891 until June 1895 when the Anaconda Copper Mining Co. was organized. In 1955, as the result of its great diversity in mining, metallurgical and manufacturing activities, the company's name was changed to what it is today.

## Early Mining Operations Set Stage for Future

In respect to the term "industrial minerals" it may be stated that in the early days of gold and silver mining in the Butte District, even the foundations required for setting up steam hoists and compressors were constructed of masonry or dimension stone such as shaped granite, or aplite blocks. One of these old type foundations is still in existence at the old Bluebird (silver) mine site about five miles west of Butte. The rock used in this foundation was andesite obtained from a locality eight miles west of Butte. Also, some of the earlier hoists at Butte's silver and copper mines were constructed of rock masonry until the advent of reinforced concrete.

During the early day mining of silver ores in the Butte District, the operators considered any association of sphalerite or zinc blend in the silver ore as "poison" which resulted in the early closing of many such mines, particularly after the financial panic of 1893. In the chloridizing roasting and amalgamation treatment of ores in those days, recoveries of silver and gold in the ores were substantially reduced if any zinc was present. When it was discovered in the 1880's that some of the silver ores in the oxidized portions of the Anaconda vein and other veins on the Anaconda Hill changed to predominant copper mineralization, mostly of the secondary type on upper levels, mining operations soon disclosed that copper ore was destined to be developed in abundance. From then until about 1900, seven or more mills and smelters were built in the Butte District. In smelting these high grade copper ores and concentrates, deposits of fluxing materials were located at points nearest the plants and exploited. For example, limestone deposits near old Montana City, south of Helena, and near Whitehall, Mont., furnished limerock to F. A. Heinze's Montana Ore Purchasing Company's smelter, the Boston & Montana Company's and other smelters at Butte. Prior to about 1900, sandy quartzite averaging 95 percent or more in silica was mined by open cut from a deposit at Daly Spur about 15 miles south of Dillon, Mont. This fluxing material was used principally at the so-called "Old Works" smelter at Anaconda. The present Anaconda smelter obtains its limestone and silica requirements from quarries about five miles west of the town of Anaconda. Fortunately, there is an abundance of deposits of limestone and quartzite near the Anaconda smelter. Silica brick, as required, has been manufactured for use in lining the reverberatory furnaces, as well as for fluxing purposes. Naturally, with mill and smelter development, sources of nearby adequate water supply were obtained and utilized, water really being of primary importance as an industrial mineral. Simultaneously, the location of necessary fuel for smelting purposes resulted in the development and exploitation of coal beds at Storrs and Cokedale in Gallatin and Park Counties, Mont., at Diamondville, Wyo., and at Belt and Sand Coulee in Cascade County, Mont., the latter furnishing coal and coke supply to the Smelter at Great Falls. With the discovery and development of the large gas fields in the vicinity of Shelby and Cut Bank during the period 1915 to 1931, Anaconda, in 1931, through the Montana Power Co. sponsored building a pipeline to Anaconda and Butte to furnish natural gas as a fuel to replace coal. In 1938, natural gas replaced coal at the Great Falls smelter. The gas came from wells in smaller fields east of Shelby operated and later acquired by Montana Dakota Utilities Co. Anaconda undertook a thorough investigation of oil and gas possibilities in Montana from the time of discovery of oil in the Cat Creek and Shelby fields, and formed West Dome Oil Co. as an exploration unit which had only limited success in the venture in the Cat Creek field during the early 1920's. A large gas reserve adequate for smelter consumption for many years was confirmed only after years of exploration by several companies in the large Cut Bank field. Thus, the development and utilization of another resource further advanced the company's industrial progress. Even in more recent years Anaconda geologists have continued the study of natural gas and oil possibilities from Alberta southerly to the San Juan field in New Mexico.

In going back to the metal mining progress of Anaconda, as the development of copper-bearing veins in the Butte District proceeded, it was recognized that many copper ore bodies became "zincy" as drifting extended into

the so-called "periphery" of the central copper zone. In 1912 to 1914 so much copper-zinc ore had been developed that the problem arose as to whether or not such material should be mined and shipped as "copper" ore, and thereby lose the zinc in the smelter slag. If such material contained two percent or more copper, irrespective of the zinc content it was shipped for copper ore. In about 1914, Frederick Laist, chief metallurgist for Anaconda with Russel B. Caples and associates in the metallurgical department, undertook research work on such complex zinc-copper-iron sulphide ore. Successful results were achieved in differential flotation of the various sulphides, roasting of the zinc concentrate and development of electrolytic deposition of zinc from zinc sulphate solution. After buildng a pilot plant for experimental work at Anaconda, a large plant was rushed to produce 6,000,000 pounds of electrolytic zinc per month, which started operation in October 1916. A new page of history was written with this accomplishment. Thus it was soon detected that our zinc ores contained silver, gold, cadium and indium, which are recoverable by-products today. Even a little gallium has been obtained on a laboratory basis.

## Aluminum-From-Clay Work Started in 1920

In about 1920, the use of high-priced aluminum for starting sheets in the electrolytic deposition of zinc at Anaconda gave incentive to the investigation of clay deposits, generally in the United States, based on the ultimate expediency of developing a process for extracting alumina therefrom. This investigation has been resumed in the past two years, and such a process has been developed by Anaconda's metallurgists. The company decided to invest one million dollars in a 50-ton alumina pilot plant at Anaconda for processing clays from large deposits near Moscow, Idaho, or from any other locality having high grade clay amenable to treatment. This process of extracting alumina from clay gives promise of matching the great achievements made in the development of the flotation concentration process and the electrolytic deposition of zinc.

Construction of the Anaconda Aluminum Company's reduction plant near Columbia Falls, Mont., was started during the second quarter of 1953 and was completed and brought into production during the summer of 1955. Production in that first year was 29,600,734 pounds of aluminum and increased to 123,024,807 pounds in 1956.

Until alumina can be produced in quantity from clays, the plant at Columbia Falls will continue to obtain it under a contract with the Reynolds Metals Co. to furnish the requirements for the present plant.

MILLING—a precipitating plant near Butte reclaims copper from mine water

## Sulphur Mined for Copper Recovery

During 1952, extensive waste stripping operations were undertaken on a low-grade copper deposit just west of Yerington, Nev., where a new town, Weed Heights, and a plant site for treating the ore were established.

The oxidized character of the ore requires leaching treatment with sulphuric acid, the latter being produced from roasting 25 to 30 percent sulphur ore mined from a volcanic vent type deposit located 58 miles southwest of Weed Heights and a few miles west of the Nevada-California boundary This sulphur ore contains a small amount of selenium which is obtained as a by-product in the production of $SO_2$ gas in a Fluo Solids plant from which sulphuric acid is made in the contact acid plant.

The first production of cement copper was in October 1953, upon completion of the copper leaching plant at Weed Heights. During that fall, production of oxidized copper ore amounted to 308, 200 tons averaging 0.94 percent copper, and increased to 4,590,096 tons of 0.83 per cent copper for the year 1956.

## Uranium Projects Undertaken Entirely by Company

Most interesting of the recent developments by Anaconda, since starting its uranium operations in June 1952, has been that of the scattered deposits in the vicinity of Grants in Valencia and McKinley Counties in New Mexico, and the construction of two plants for processing uranium-bearing ores from the company's properties and from other operators. Generally, two types of uranium ores are mined in the district; that is, the limestone type ore and the sandstone ore. Each type requires a different process for extraction of the uranium; the limestone ore by an alkaline leach, and the sandstone ore by an acid extraction. The ultimate product, $U_3O_8$, is shipped in canisters to the Atomic Energy Commission.

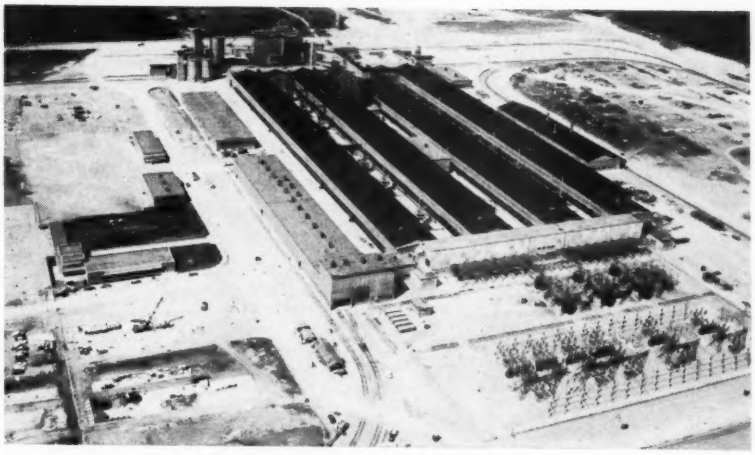
In both the limestone and sandstone formations in which the uranium occurs, the principal minerals are the yellowish carnotite and tyumunite (to-you-mu-nite). The carnotite is a hydrous potassium uranyl vanadate, and the tyumunite is somewhat similar, but includes a lime radical. Geologically, both minerals occur in the cracks and joints and as impregnations in flat-lying limestone and sandstone beds, but in richer concentrations wherever fossil wood fragments are present, thus indicating the effect of carbon in the precipitation of uranium minerals from salts carried in water percolating through such rock formations.

Anaconda now obtains most of its uranium ore production from the Jackpile mine, an open pit operation about eight miles north of Laguna and east of Grants, where overburden up to 100 ft or more is removed to permit stripping of a 10 to 25-ft bed of uranium-bearing sandstone. The ore is shipped by railroad to the leaching plants at Bluewater a few miles west of Grants. Recently, the Atomic Energy Commission's geologists estimated this so-called Jackpile deposit near Laguna contains 15,000,000 tons or more of 0.16 percent $U_3O_8$, the largest single uranium deposit yet found in the United States.

The plants at Bluewater are now treating approximately 3000 tpd of uranium-bearing ores. The company's participation in the uranium industry has met with gratifying success—the result of undertaking a major investment entirely financed and owned by the company.

One of the uranium deposits in Poison Valley, north of Grants, was found to contain selenium. Some laboratory study was done to determine

SMELTING—reduction plant at Columbia Falls, Mont., makes Anaconda an important producer of primary aluminum



the feasibility of extracting this element, should it be found generally distributed in uranium ores from other nearby localities. The erratic distribution of the selenium precluded giving serious consideration to its recovery in the ore processing plants.

### Manganese Nodules and Ferromanganese Produced

The vein type deposits in the Butte District are unique in having concentrations of rhodochrosite at some places in the outer portions of the so-called zinc bearing zones of the older East-West age veins, particularly in the Black Chief Lode or Emma vein from which most of the production of manganese ores has been mined almost continuously since 1917. Up until 1940, only high-grade rhodochrosite or "pink carbonate" ore was mined and processed, the grade of ore then running from 35 to 40 percent manganese. From 1940 to the present, lower grade ore averaging from 15 to 20 percent manganese has been successfully mined and milled to produce a good grade rhodochrosite concentrate suitable for roasting to an oxide nodule product containing 58 to 60 percent metallic manganese, or for the production of ferromanganese. In the flotation concentration of the rhodochrosite ores, zinc and lead sulphides are obtained as by-products, along with substantial silver and gold credits. Anaconda is the largest single producer of manganese products in the United States, the ore production being mostly from the Emma and Travona mines at Butte.

REFINING—electrolytic zinc plants at Anaconda and Great Falls, Mont., produce high purity zinc

FABRICATING—wire, rod and tube for a myriad of uses come from the Kenosha, Wis., tube mill of the American Brass Co., a wholly-owned Anaconda subsidiary

RESEARCH — the search for better methods and new or improved products continues in order to be ready to supply demands of the consumer

## Phosphate Reserves Large

The phosphate property owned by the company at Conda, Caribou County, Idaho, comprises about 3500 acres (exclusive of Government leases) covering the outcrops of the phosphate formation over a distance of approximately eleven miles and extending over the major portion of what is called the Aspen Range.

Phosphate rock is composed largely of tricalcic phosphate, a relatively insoluble compound which yields only a trifling amount of its phosphoric acid in the ordinary chemical processes of nature. The rock occurs in bedded form not unlike coal deposits. The material is of sedimentary origin, lying conformably on a hard chert-bearing limestone of Upper Carboniferous age. The main "footwall" phosphate bed varies from eight to ten ft in width of 28 to 32 percent $P_2O_5$ and is overlaid by approximately 130 ft of thin-bedded phosphatic shale and limestone. Above this shaly horizon is another phosphate bed six to eight ft thick, referred to as the "hangingwall" bed of about 26 to 30 percent $P_2O_5$ content. Both beds have been developed and stoped along the flanks of two anticlines. The tops of these anticlines have been eroded in most places, and some local synclinal remnants have afforded limited open-pit strip mining during the past five years.

Since the start of operations on the Conda property in 1920, a total of 3,427,086 tons of phosphate rock has been produced, of which 260,000 tons were mined by pit stripping.

The developed, probable and possible phosphate reserves on this property are sufficient for many years of operation in the future.

In the phosphate treatment plant at Anaconda, vanadium pentoxide (red cake) was produced for several years as a by-product from the manufacture of phosphoric acid. The crude rock from the footwall phosphate bed at Conda contains about 0.2 percent $V_2O_5$, and the other bed has practically no vanadium. The mixing of these two ore products into one charge has precluded the profitable recovery of vanadium subsequent to 1954.

## Chromite Developed During Emergency

During World War II, there was a steadily increasing demand for chromite due to Government stockpiling, increased consumption by expanding war industries, and decreased imports of chromite as foreign supplies became unavailable with the spread of war. It was recognized that this condition would become acute with prolongation of the war. For this reason the Government, operating through its Metals Reserve Co. and the Defense Plant Corp., decided to develop the chromite deposits existing in the so-called Stillwater Complex, a belt of metamorphosed rock formations 26 miles long located along the north margin of the rugged Beartooth Mountains in Stillwater and Sweet Grass Counties in south central Montana. During 1941, the Government agencies negotiated with Anaconda for development and production of ore from several of these chromite deposits, operations to be conducted on a non-profit basis. The principal properties included in this agreement were the Mouat-Sampson, Mouat, Benbow and Gish holdings. The company undertook extensive development on the chromite veins from 1941 until the closing of these mines in September 1943. Drifting and raising was done in the chrome (picotite) ore aggregating many thousands of feet. Several millions of tons of ore were developed. Simultaneously with the development of these mines, two mills were constructed and completed within nine months of commencement date, another achievement accomplished by the technical staff in the mining and metallurgical departments.

**ANACONDA'S 1956 PRODUCTION**

| | |
|---|---|
| COPPER | 1,138,521,363 lb |
| ZINC | 443,995,842 lb |
| ALUMINUM | 123,024,807 lb |
| LEAD | 89,576,057 lb |
| SILVER | 12,006,314 oz |
| GOLD | 78,847 oz |
| CADMIUM | 1,956,315 lb |
| MANGANESE | 72,834 short tons |
| FERROMANGANESE | 39,671 short tons |
| ARSENIC | 2,121 tons |
| PHOSPHATES (and phosphoric acid) | 80,770 tons |

During the relatively brief period of operations, the Benbow mill with a capacity of about 500 tpd produced about 73,000 tons of concentrates averaging 41.45 percent $Cr_2O_3$ and 17.52 percent iron. Also, the Mouat mill, which was operated for six months, processed about 78,000 tons of ore which yielded nearly 30,000 tons of concentrate averaging 38.65 percent $Cr_2O_3$ and 18.36 percent iron.

During the past few years the American Chrome Co. has continued to operate on the Mouat property after re-opening the mine and restoring the camp and mill facilities for the production of chrome concentrates that are sold to eastern markets.

## Magnesium Important War Material

Also in 1942, during World War II, the Government's Defense Plant Corp. made a proposal to Anaconda to take over management control of Basic Magnesium, Inc., operations at Henderson, Nev. Upon completion of construction of this immense plant, the first production of metallic magnesium was in August 1942, and peak production was reached in July 1943 with output at the rate of 120,000,000 lb per yr—substantially more than the original estimated 112,000,000 lb capacity of the plant. Production at this plant increased to eighty times the pre-war production of magnesium in the entire country. About 95 percent of all the magnesium produced between 1941 and 1945 was used in bomb alloy or powder. Late in 1944, production was terminated by Government order.

## Molybdenite Recovery Studied

During the 1930's and 1940's, molybdenite was an important by-product obtained in the concentration of copper ores produced from the rich La Colorada ore body at Cananea, Mexico. Molybdenite has been detected in veins on some of the deeper levels of Butte mines, but is insufficient in quantity to have been of commercial importance up to the present time. Consideration is being given to the possible separation of molybdenite from copper concentrates if and whenever warranted. Molybdenum bearing prospects in Montana, Utah and Nevada have been examined and in some places explored by diamond drilling with hope of finding a commercial deposit.

At Chuquicamata, Chile, a plant is now under construction for the separation of molybdenite which occurs in sufficient quantity to recover as a by-product.

## Gold, Silver and Nonferrous Ores Are Interdependent

The past record of Anaconda in conducting geological, mining and metallurgical investigations of various type mineral deposits has demonstrated that any mineral, either metallic or non-metallic, may become industrially important. Without the extensive operations on nonferrous type ores and metals, by larger mining and metallurgical concerns such as Anaconda, Kennecott, Asarco, Newmont, American Metals, U. S. Smelting, and others, the production of gold and silver would be inadequate to meet the demand. The continued production from copper, zinc, and lead-bearing deposits henceforth must be depended upon to furnish the requirements of the market, particularly for silver, and it is to be hoped that adequate tariff regulations will be established on foreign imports to protect

*(Continued on page 32)*

Principal advantages of the single-machine method as it applies to the River Queen mine are: (1) Maximum utilization can be made of the spoiling capacity of the large stripper and (2) only one machine is required to strip two seams

# Two Seam Stripping and Parting Removal

## A specially designed 55-cu yd shovel has simplified the job of strip mining two seams of coal at the River Queen mine

Rating of the tipple is 800 tph from the pit and 600 tph from the storage bin, or a total of 1400 tph through the preparation plant

By FRANK GILBERT
Superintendent
River Queen Mine
Peabody Coal Co.

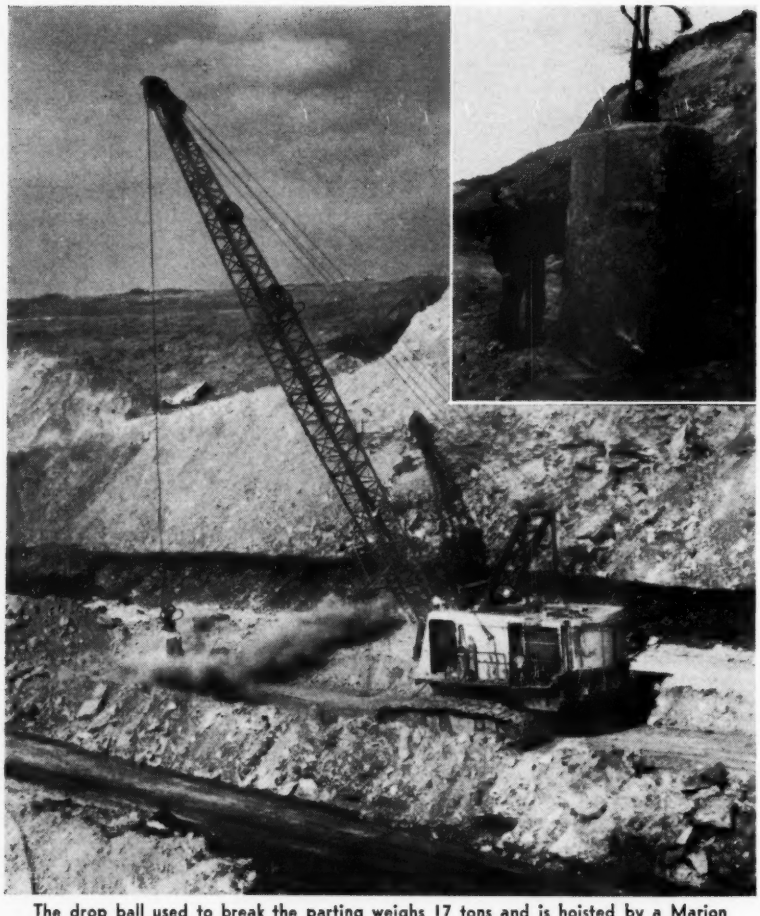
THE River Queen operation is one of the Peabody Coal Co. strip mines in western Kentucky. It is near Greenville. The No. 11 and 12 seams are being stripped with an approximate average cover of 48 ft. Each seam is about five-ft thick. There is some soil mantle but the overburden consists mostly of sandrock and shale. The parting between the two seams varies to some extent but it averages about 11-ft thick. Roughly eight ft of the lower portion of this parting is hard limerock, with the remaining top three feet consisting of fire clay, or in some instances a dense layer of shale. The topography is hilly, which is typical of western Kentucky.

### Main Shovel Strips Both Seams

Stripping was considered one of the critical problems when planning the two-seam mining operation. Preliminary considerations indicated two general procedures, or methods, that should be evaluated.

One method would employ the main stripping shovel on the top surface of the No. 12 coal. This machine would strip only the top overburden and spoil it to the side. In doing so it must place the spoil far enough away to leave room for the parting spoil which would be moved later. After the No. 12 coal was loaded out the parting would then be removed by a smaller machine, such as a quarry mining shovel with a six-cu yd dipper, and spoiled in the space left available by the large stripper.

The second method is one in which the main stripping shovel would be used to strip both seams at the same time. This method called for the shovel working from the top of the lower seam, the No. 11 coal. The upper overburden would be removed from the side, the shovel swinging approximately 180° to deposit the spoil. In addition, plans called for removing the parting by digging straight ahead, depositing this spoil to the side. The parting, which is mostly broken limerock, is the most desirable material for building the toe and bottom part of a spoil pile. Therefore, the parting spoil would be placed ahead in



The drop ball used to break the parting weighs 17 tons and is hoisted by a Marion 111-M diesel electric machine rigged as a crane. The breakage blow is applied on about six-ft centers to the parting surface, resulting in excellent fragmentation. Inset shows close-up of drop ball

the form of a berm or buckwall and thus form the foundation for the top overburden spoil. The top overburden spoil would then be placed on top.

The single-machine method for mining two coal seams used at the Will Scarlet Mine of the Stonefort Corp. in southern Illinois was closely studied. Through the cooperation of the Stonefort personnel, especially William Dukes, valuable planning information was obtained. The single-machine method was decided upon to perform the two-seam stripping required at the River Queen. Principal advantages of the method as it applies to the River Queen are: First, maximum utilization can be made of the spoiling capacity of the large stripper. Second, only one machine is required to perform the dual functions of stripping the two seams.

## Shipper Shaft Moved 12-Ft up the Boom

In order to accomplish two-seam stripping job, the stripper had to be constructed with special features. A Bucyrus-Erie 1650-B Shovel—with long range front end and equipped with a new Amplistat electric control to speed up the digging cycle—was selected for the job. The boom is 145 ft long, the dipper handle is 86 ft long, effective length, and the dipper capacity is 55 cu yd. Through cooperation with Bucyrus-Erie Co. personnel, a special front-end arrangement was provided—the principal change involved moving the shipper shaft about 12 ft up the boom from the normal position. The handle length was adjusted to suit this change. With this front end, and by keeping the equalizing jacks extended about three ft, a level floor 16½ ft above machine track level of sufficient range is available to give a 45-ft wide side cut above No. 12 coal. In other words, with the equalizing jacks extended, the machine can dig to the side and strip a 45-ft wide cut exposing the No. 12 coal top surface without the dipper heeling. The machine can dig a level floor of 96-ft radius at track level. This facilitates digging the parting.

## Preparation of Overburden and Parting for Digging

Drilling and blasting of the top overburden is accomplished with a Bucyrus-Erie 50-R dry rotary vertical drill using 10⅝-in. diameter bits and low density ammonium nitrate explosives. In order to eliminate "blowing over" the high wall on the No. 12 coal seam, it is necessary to blast one cut ahead of the stripping. This, of course, means buffer shooting which we feel provides an advantage in giving better fragmentation.

A unique procedure is used to prepare the parting for digging. As far as is known, the method was pioneered at the River Queen mine. The 45-ft wide strip of parting is divided roughly in half parallel to the highwall.

The outside 25-ft strip is broken up with a drop ball—an operation similar to that used for secondary breakage in many stone quarries. The drop ball, however, is much larger. It is actually a steel billet about eight-ft long, 60-in. wide, 30-in. thick, and weighs 17 tons. It is hoisted by a Marion 111-M diesel electric machine rigged as a crane. The breakage blow is applied on about 6-ft centers to the parting surface. The fall is approximately 50 ft and the time interval between drops is about 45 seconds. It can readily be seen that the energy delivered to the surface of the limerock parting is tremendous. Excellent fragmentation has resulted from the use of the drop ball, permitting good digging results. Needless to say, considerable savings in explosives result from this procedure.

The 20-ft strip nearest the high wall is drilled with an electric powered tractor unit which has been especially designed as a parting drill. It consists of three drifter type drills mounted on a crawler base and arranged for vertical drilling. After drilling, this 20-ft wide strip is blasted in the conventional manner.

## Nine-Yd Loaders and 50-Ton Trucks Used

Coal from both seams is hauled on the No. 11 seam, where a 20-ft berm is maintained to allow the routing of haulage trucks past the shovel when necessary. The Euclid haulers carry about 50 tons of coal on each trip.

Coal loading is accomplished with a 4161 Marion nine cu yd machine on each seam. The loader on the No. 12 coal level must work as closely as possible to the outside edge—that is, the edge furthest away from the high wall—in order to keep from spilling coal into the adjoining pit. For the level floor digging radius of the size

*(Continued on page 42)*

# Human Failure—

# SLEEPING GIANT

**75 percent of Minnesota's open-pit mining accidents can be traced to "Human Failure"**

By GEORGE A. BORGESON
Manager, Safety and Claims
The M. A. Hanna Co.

BENJAMIN DISRAELI once said, "there can be no economy where there is no efficiency." Although the quote is very old, it can be adapted to all types of modern industrial safety. For example, the author has been in mining for more than 37 years. Right from the beginning, he learned that safety and efficiency went hand in hand with economy and production. Without one, the other could not be. Safety, then, is a vital subject, and one that applies to all industry.

It might be well at this point to establish where open pit mining stands in the Minnesota safety picture and then talk about what is being done to further improve The M. A. Hanna Company's safety performance.

The most recent figures available show that 83 percent of all industries in the state of Minnesota had a higher accident frequency rate than the mines in the state.

The next logical point would be to break down mining accident causes and explain what is being done about them. A look at the accident records in open pit mining, finds that 75 percent of the accidents can be traced back to "Human Failure," 12 percent to "Unsafe Conditions," 11 percent to "Normal Job Hazards," and the remaining two percent to "Acts of God."

Human Failure is the largest single cause a mining accident, so let's talk about that first. This article is entitled, "Human Failure—A Sleeping Giant." And a sleeping giant it is. Think about it for a moment. The sleeping giant—human failure—affects us all.

Take the public speaker as an illustration. Most speakers usually say that they are glad to be invited to speak before a group. In reality, most of them are scared stiff. In line with this, one is reminded of a woman who upon entering a room in a Washington hotel recognized a well-known government official pacing up and down. The woman asked what he was doing there. "I'm going to deliver a speech shortly," he said.

"Do you usually get nervous before addressing a large audience?"

"Nervous?" he replied. "No, I never get nervous."

"In that case," demanded the lady, "what are you doing in the Ladies' Room?"

Although there is humor in this story, there is also an indication of human failure. To be frightened or nervous about standing before, and talking to, your fellow men is nothing more than a human weakness. Analyze it. A man has more than a quarter century of experience in a given field. He is asked to discuss his experience. He spends weeks organizing his thoughts and preparing his delivery. No one could be better prepared. But on the day of the speech, we find our sleeping giant—yes, human failure—has been awakened. The giant rears its ugly head and before you know it, our expert is frantically pacing the floor of the Ladies' Room.

Human failure causes individuals to do strange, almost unbelievable and unnatural things. The sleeping giant is the crux of safety problems, too. What else would cause the painter, standing on a three-ft wide scaffold, 20 ft above ground, to take five steps back to examine his work? Or what made the work man, who was asked to saw off the branch of a tree, sit on the outside and do his sawing? Both examples seem ridiculous but, believe it or not, they both happened. One in the steel industry and the other in mining.

**George A. Borgeson is a native of Duluth, Minn. He has been employed by M. A. Hanna Co. since 1921, when he began his career as a mine clerk. Borgeson is past president of the Lake Superior Mines Safety Council and presently a member of its executive committee. He is also on the executive committee of the Mining Section, National Safety Council.**

## Personnel Systematically Reminded of Safety

Because human failure is the cause of most mining accidents, much of the safety effort must be spent in this area. It seems the best method of combating the condition is to keep safety before personnel at all times and in as many different ways as humanly possible. The activity nar-

rows down to being almost an advertising campaign. If an employe is thinking safety he will act safely and the sleeping giant will continue snoozing.

The safety picture at Hanna is kept before personnel in many ways. The first is through a regular monthly safety meeting for both employes and supervisors. The safety meeting is a "must" for everyone. At these meetings, accidents, near accidents, and unsafe practices are thoroughly covered. The overall result of these meetings is reflected in better and safer work methods.

Safety meeting agenda are also supplemented with motion pictures which are furnished by the National Safety Council and other agencies. The contents of the motion picture are reviewed verbally and when possible applied to company safety problems.

Last and certainly not least, suggestions from employes are welcomed and encouraged. On many occasions, the man working right on the job can come up with a solution to a problem that someone "on the outside looking in" would find difficult to solve.

Safety meetings have been effective and have contributed greatly in the never-ending battle with the sleeping giant. However, to follow up these meetings several other practices have been put into operation. One is the utilization of changeable signs, calling attention to the number of days since the last lost-time accident occurred at a given mine. Another way to keep safety before all personnel is through a poster campaign. The colorful posters are supplied by various safety agencies.

To this point, a more-or-less blanket coverage with safety meetings, signs, and the poster campaign has been achieved. The next step has been to take safety reminders right to the actual job. This is accomplished by having specific safety rules, governing either equipment or the job, printed on decals so they may be posted on the equipment or in a particular work area.

At Hanna, incentive has proven to be an effective safety tool. To induce incentive, a group safety award program has been established. Under this program, all employes are eligible to receive awards which are useful off the job, for having perfect records over an entire year. The awards have included fishing rods and reels, electric frying pans, blankets, clocks, electric drills, and other useful items. The awards are made to all employes, and to be eligible the entire working force at a mine must have a perfect record. The program does several things. First, each man is trying to work safely himself. An added plus is that he becomes his "brother's keeper" because the success of the program not only depends on individual effort, but requires teamwork as well. Because of the type of award—something that can be used off the job—the safety program has received plenty of interest from wives and children of employes.

THE HANNA MINER
AVOID INJURY—WATCH YOURSELF!
FOUR DON'TS FOR SHOVEL MEN
Don't leave the dipper of the shovel suspended. This practice is dangerous because there is always the chance of brake failure and if someone walks under dipper, it can result in an accident.
Don't swing unbalanced loads. Large rock in dipper above could easily fall off and might injure the Truck Driver, Shovel Operator or Oiler. It could also result in costly damage to equipment.
Don't walk or work under suspended loads. Many of the injuries in mining are caused because an employee fails to observe this important safety regulation. Avoid injury. Stay clear of dipper.
Don't jump from equipment. Injuries ranging from sprains to fractures have resulted from this unsafe practice. When descending from larger equipment, use railings and steps which are provided.
DO WORK SAFELY EVERY DAY!

Safety reminders are taken into employee's homes through a regular full-page safety feature in the company publication, "The Hanna Miner"

Another way safety is taken into employes' homes is through a regular full-page safety feature in the company publication, *The Hanna Miner*. These features, all of which have been pictorial, point out job hazards, the "do" and "don't" technique, and other pertinent safety points. The foundation for a successful accident prevention program depends on the willingness and efficiency of foremen and superintendents to carry through the program. Supervision has been charged with the responsibility of literally putting safety first.

Hanna has started using an "unsafe practice" report form. This is used in addition to the regular accident report which is universally used throughout most of industry. The unsafe practice report has proven valuable in helping keep the sleeping giant in slumberland.

## Campaign Helps Prevent Accidents

Of course, all of these techniques are difficult to measure for effectiveness. By their very nature, the results are intangible. But, one can get a clear understanding of the psychology behind these methods by recalling the story of the conversation between a sales manager and the advertising manager.

"I defy you," said the sales manager, "to show me one order that advertising ever put on our books."

"I will," promised the advertising manager, "just as soon as you can show me a single load of hay that the sun ever put in a barn."

No, it cannot be said exactly which

## THE M.A. HANNA COMPANY

### SHOVEL SAFETY REGULATIONS

**MOVING**

1. THE OILER MUST BE ON THE GROUND FOR ALL MOVES. (EXCEPTION WILL BE MADE FOR SHORT MOVES AHEAD. THE OPERATOR MUST KNOW WHERE THE OILER IS BEFORE MAKING A MOVE.)
2. OPERATOR WILL SIGNAL FOR ALL MOVES. 1 SIGNAL STOP
   2 SIGNALS FORWARD
   3 SIGNALS REVERSE
3. OPERATOR WILL NOT MOVE SHOVEL AHEAD UNTIL SIGNAL IS RETURNED BY THE OILER AND BEFORE MOVING BACKWARDS MUST SWING SHOVEL TO CHECK POSITION OF OILER.
4. STAND IN THE CLEAR WHEN USING TRACK PLUG. NEVER USE A DIPPER TOOTH AS A SUBSTITUTE FOR A PLUG.
5. LOCK SWING MECHANISM ON LONG MOVES.
6. KEEP DIPPER CLEAR OF CREWS HELPING ON LONG MOVES.
7. OPERATOR SHALL REMOVE ALL LOOSE OR OVERHANGING ROCKS AND CHUNKS FROM THE BANK AS THEY PROGRESS THROUGHOUT THE CUT AND KEEP PIT CLEAN OF ROCKS BEFORE MOVING FORWARD.
8. DURING MOVING BE SURE TO STAND IN CLEAR OF SHOVEL CABLE BOAT.
9. WHEN MOVING SHOVEL ON GRADES, USE RECOMMENDED PROCEDURE.

**OILING**

1. OILER MUST NOTIFY OPERATOR WHEN HE GOES UP ON THE BOOM.
2. UNDERCARRIAGE AND CIRCLE SHALL NOT BE GREASED WHILE SHOVEL IS IN OPERATION.
3. ALL CONTAINERS USED ON SHOVELS MUST BE LABELED TO SHOW THE CONTENTS OF THE CONTAINER.

**GENERAL**

1. NOTIFY THE OPERATOR WHEN GETTING OFF OR ON THE SHOVEL. SHOVEL TO STOP FOR ALL PERSONNEL. NEVER JUMP FROM SHOVEL BUT USE GRAB IRONS PROVIDED.
2. SHOVEL CREWS MUST WEAR EYE PROTECTION WHEN CHANGING TEETH, MAKING REPAIRS OR HAMMERING STEEL ON STEEL. OPERATOR MUST NOT PERMIT OTHER MEN TO ASSIST IN CHANGING TEETH, ETC., UNLESS THEY ARE WEARING EYE PROTECTION.
3. KEEP ALL GUARDS IN PLACE AND DO NOT REMOVE GUARDS FOR CONVENIENCE OF OILING OR OPERATING.
4. CAUTION MUST BE EXERCISED WHENEVER A BULLDOZER IS WORKING AROUND A SHOVEL.
5. ALL PERSONNEL MUST STAY OUT OF AREA BELOW THE ARC OF SHOVEL SWING.
6. BEFORE SWINGING DIPPER TO THE REAR BE SURE DIPPER IS CLEAN.
7. LIST ALL UNSAFE CONDITIONS AND EQUIPMENT ON YOUR SHOVEL REPORT.
8. NO ONE TO GO UNDER BOOM UNTIL OPERATOR IS NOTIFIED AND BUCKET IS LOWERED AND SET ON THE GROUND.
9. KEEP SHOVEL CLEAN AT ALL TIMES.
10. FIRE EXTINGUISHERS MUST BE CHECKED EACH SHIFT BY OILER.
11. NOTIFY TRUCK DRIVER WHEN LARGE CHUNKS ARE BEING LOADED.

**Safety reminders on the job include specific rules, governing either equipment or the job, printed on decals so they may be posted on the equipment or in a particular work area**

safety promotion—posters, contests, meetings—is eliminating accidents, but it is sure that they are responsible for stopping some of them.

Protective clothing and equipment issued for use under certain conditions has proved valuable in preventing injuries. In many cases, use of protective clothing is governed by rule. For example, drill crews must wear hard hats at all times. If an employe becomes negligent in this respect, the foreman or superintendent is always on hand with a firm but friendly reminder.

Now what about the "causes" and "cures" for the 12 percent of accidents attributed to "Unsafe Conditions"? Unsafe conditions include such things as bad order equipment, narrow roads, and improperly covered drill holes. In the author's opinion, the sleeping giant has a hand in these accidents, too. What else could possess a man to ignore such conditions?

The elimination of these conditions is a responsibility management has accepted. Through this acceptance and the constant work to stop "Human Failure," it is hoped these percentages will change for the better in the future.

The last cause of accidents has been determined to be "Normal Job Hazards." As stated before, this was responsible for 11 percent of mining accidents. Normal job hazards are things inherent to the mining business. These would include slippery conditions brought on by the weather, rocks and chunks of ore and dirt falling from the banks, operation of heavy machinery, blasting and others. Let's quickly consider what mining has done about them.

It has been possible to minimize some of the natural hazards in the pit by regularly trimming banks, especially after thaws or rainfall. Riprapping unstable banks with rock has proved a good method of reducing dirt slides in the pit, too.

### Safety Devices Reduce Hazards

Equipment-wise, Hanna has installed many safety devices which have reduced considerably the hazards encountered in the operation of heavy machinery. For example, 29-T and 42-T churn drills and 50-R rotary drills are used for both exploratory work and for blasting preparation. Many safety devices, such as operator's shelter, fencing off the moving machinery area, power-operated turntable and safety chains on parts of overhead equipment, have made the drills safer pieces of equipment to operate. In addition, platforms, ladders, and steps have also contributed to safer operation of this and other equipment.

Several safety devices have been added to the 22 and 34-ton haulage trucks commonly used in open-pit mines. Among the safety-guards installed on trucks is neutral starting. Of course, neutral starting has prevented the chance of the driver inadvertently attempting to start the truck while it is in gear and causing the vehicle to lurch forward or backward. At the present time, the company is working on a method of preventing the hoist from operating if the convertor or transmission is in reverse position. This innovation will completely eliminate the possibility of the driver accidentally causing his truck to back over a bank when dumping his load.

Safety regulations pertaining to tractors, graders, and miscellaneous equipment have been introduced and proved successful. The regulations cover such things as proper break-in periods for operators, and good housekeeping. In addition, regular union-management inspections are conducted. An excellent way to keep abreast of equipment conditions is through a daily equipment report submitted by the operators. The reports are directed to the Mechanical Department and indicated repairs are immediately made.

Generally speaking, 6½ cu yd electric shovels are used in open pit mining. Safe operation of shovels has been approached from two angles. First, an attempt has been made to restrict the location of the shovel to a safe work area by limiting the bank

on which the shovel is working to a height no greater than that of the boom's point sheave. Naturally, the second way has been by including safeguards such as power shifting for steering clutches, shielded power cables, and a good ground fault system. All these installations and the rules governing operation have contributed greatly to the safety of both the operator and oiler.

### Caution With Explosives Emphasized

As mentioned earlier, blasting is another of the normal job hazards of open pit mining. All blasting is approached with equal caution regardless of sensitivity. It's sort of a "if you can't trust some of them, don't trust any of them" rule.

Starting from the beginning, all powders are stored in safe steel sheds. Detonators and other supplies are kept in separate wooden boxes and all equipment is kept under lock and key at all times. When there is blasting to be done, the pit is cleared and preparations are made to fire the shot. When all is ready, the foreman is charged with the responsibility of double checking that all is clear. Not until he gives the O.K. on clearance is the charge fired. Naturally, people handling explosives are thoroughly trained and work closely with supervisors at all times. As an extra safety precaution, all employes, at one time or another, have had the opportunity to see a 25-minute sound film, produced by Hanna, concerning blasting safety. In this way, by making our employes cognizant of the dangers of blasting and the need for careful handling, safe storage of explosives and close supervision, most of the dangers connected with this necessary activity are eliminated.

This then briefly, is how Hanna is handling safety in open pit mines. The company is using Napoleon's strategy of "divide and conquer" by separating accident causes into three categories—"Normal Job Hazards," "Unsafe Conditions," and last, but far from least, the sleeping giant, "Human Failure." The open pit safety program is large and complicated. The company operates 15 open pits or groups of mines in Minnesota and employs approximately 3,000 men. It has a definite safety responsibility to these people.

On a state-wide basis, Minnesota mining includes 17 companies operating more than 100 active mines and employing 19,000 men. Multiply the program just outlined by the total number of people employed in Minnesota mining and one can get a better idea of the tremendous scope of mining safety. On a national basis, business learned long ago it should not, in its attempts to elevate itself, lose sight of safety. Safety must go hand-in-hand with efficiency and production.

## DIVERSIFICATION—KEY TO GROWTH OF ANACONDA

*(Continued from page 26)*

our domestic producers in the continued operations of their mines. In fact, the gold and silver credits in copper, zinc and lead ores usually are in sufficient amounts to enable an operator to lower the cutoff grade of the basic metal content of the ore, really an item of conservation to obtain maximum metal recoveries and increase ore reserves in the marginal grade bracket. Actually the salvaging of sulphur in the form of sulphuric acid is also a credit item.

At refineries where anode sludges from the various electrolytic copper and zinc plants are received for further treatment, such as at the Raritan Plant at Perth Amboy, N. J., by-products other than silver and gold are recovered, including platinum, palladium, indium, bismuth and selenium. During 1956 Butte ores produced 56.5 percent of the company's total silver production and about 40 percent of the total gold. The production of uranium oxide is classified information.

### Other Resources to Be Added

Along with plans for expansion and diversification of mining, metallurgical and manufacturing interests, the long term outlook appears promising. Increasing interest is being taken in resources other than copper, zinc and lead, particularly of those metals having potential importance in the future such as titanium, thorium, zirconium, columbium, tungsten, and lithium. Some non-ferrous mining companies are going into non-metallic fields such as asbestos.

In short, the modern trend of diversification has proved highly beneficial to Anaconda and to other companies, whether in mining or manufacturing. The vital need for some product is the spark that induces investigation of sources of that product and its ultimate development, provided economic conditions are favorable.

In the smelting operations on copper, zinc and lead ores, losses in smelter fumes are constantly being minimized by electrostatic precipitation of flue dust containing arsenic, antimony, bismuth, sulphur and other volatile fine dust material—particularly for the salvaging of arsenic.

The recovery of sulphuric acid from the pyrite in copper and zinc ores, by flotation and a contact calalytic process, is important—even though only a small proportion of the sulphur in such ores is recovered. The principal use of the acid is in the treatment of raw phosphate rock for the production of phosphoric acid used in making treble superphosphate fertilizer products. A recent decision has been made to manufacture an "Ammo-phosphate" fertilizer, thereby utilizing further natural resources. Nitrogen and hydrogen, used in the manufacture of anhydrous ammonia, will be obtained from the Geneva plant in Utah to make "Ammophos" at Anaconda.

In roasting pyrite concentrates at Anaconda, the "sponge iron" residue has become useful in the so-called "L.P.F." (Leach-Precipitation-Float) treatment. It is used for precipitating the soluble copper from mill water in the concentration of partially oxidized, low-grade copper ore that is mined from upper levels of the Kelley mine at Butte. Minute, flaky copper thus precipitated can be concentrated with the sulphides in the flotation plant.

### Progressive Outlook Continues

An endeavor has been made to briefly tell a success story of the Anaconda organization starting practically at "grass-roots" about 75 years ago which, because of aggressiveness and a plan of expansion and diversification of interests related to the production of metals from "Mine to Consumer," is an example of what can be accomplished as a result of our country's sponsorship of free enterprise in the development and utilization of mineral resources.

Anaconda's geological department has investigated and given consideration to certain titanium-iron-bearing deposits in the western states, and to deposits of iron ore at other localities in North America. Also, investigations have been made of oil and gas possibilities in areas tributary to its smelters. Examinations have been made of chrome and nickel-copper-bearing deposits, also of miscellaneous deposits having showings of uranium, thorium, molybdenite, tungsten, asbestos, fluorite and barite, and even gold prospects; all with the hope of developing a large enough resource upon which to initiate a productive and profitable operation.

Consideration and study has been given by the metallurgical research department to the possibility of salvaging more sulphur from the smelting of sulphide ores and concentrates, and to obtaining, by differential flotation, a kaolin product from upper zone low-grade copper ore tailings of the Berkeley and Kelley mines at Butte, with the object of extracting alumina therefrom for treatment at Columbia Falls, Mont. Also, consideration has been given to the possibility of making hydraulic cement and "rock wool" from smelter slag. At present, the market range is too limited for the latter products to make them a profitable venture.

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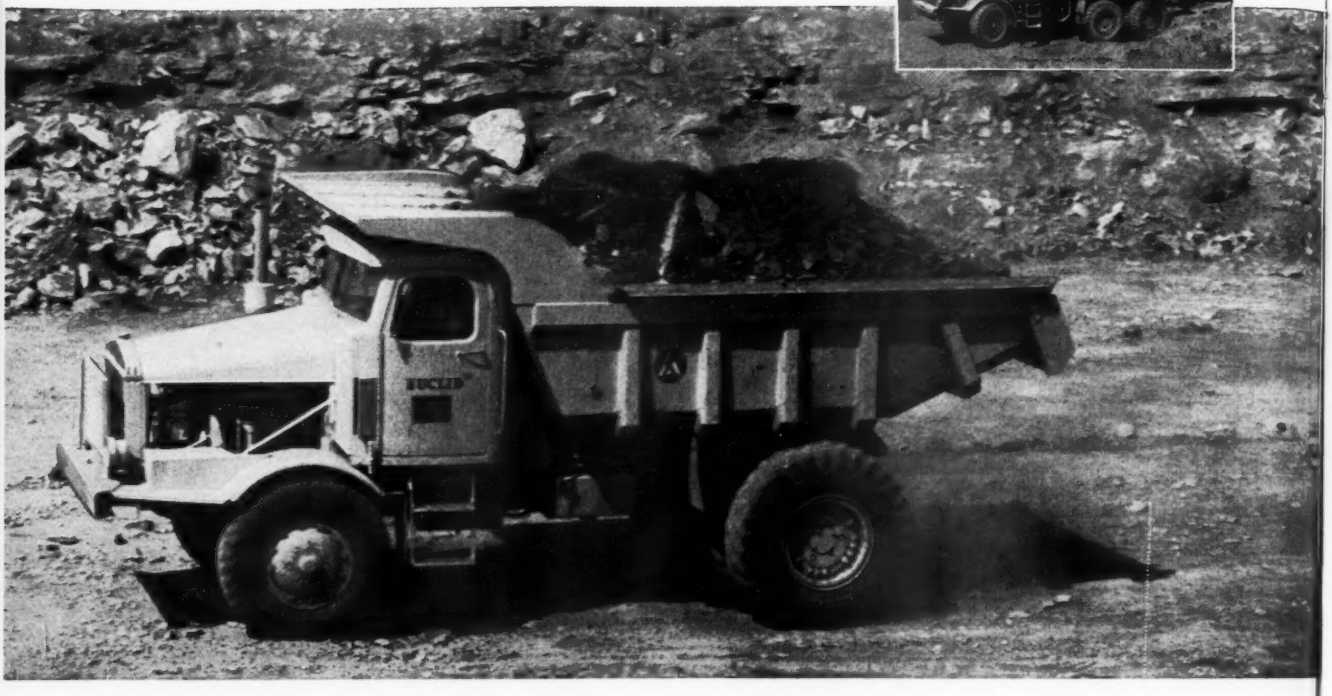


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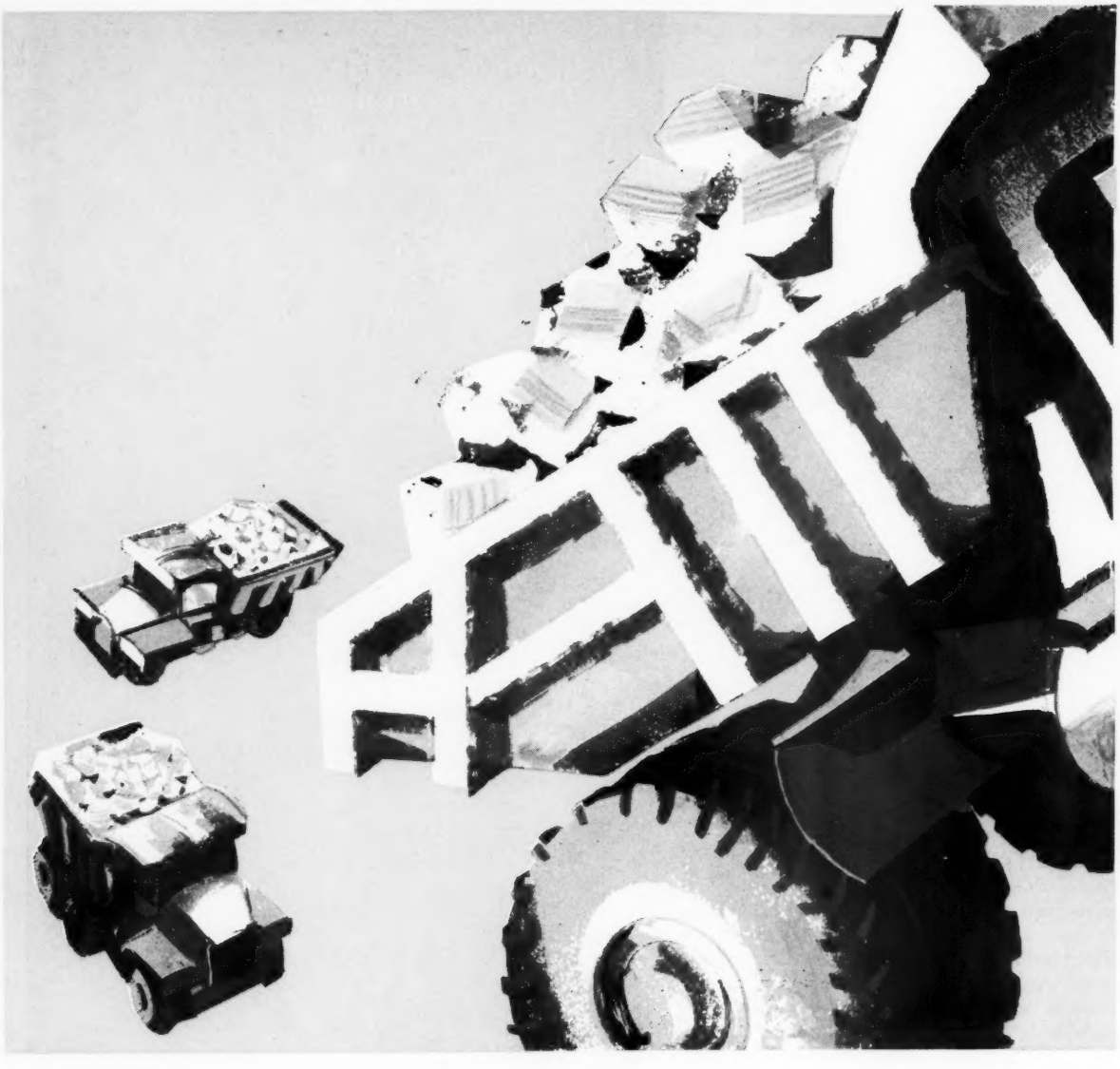

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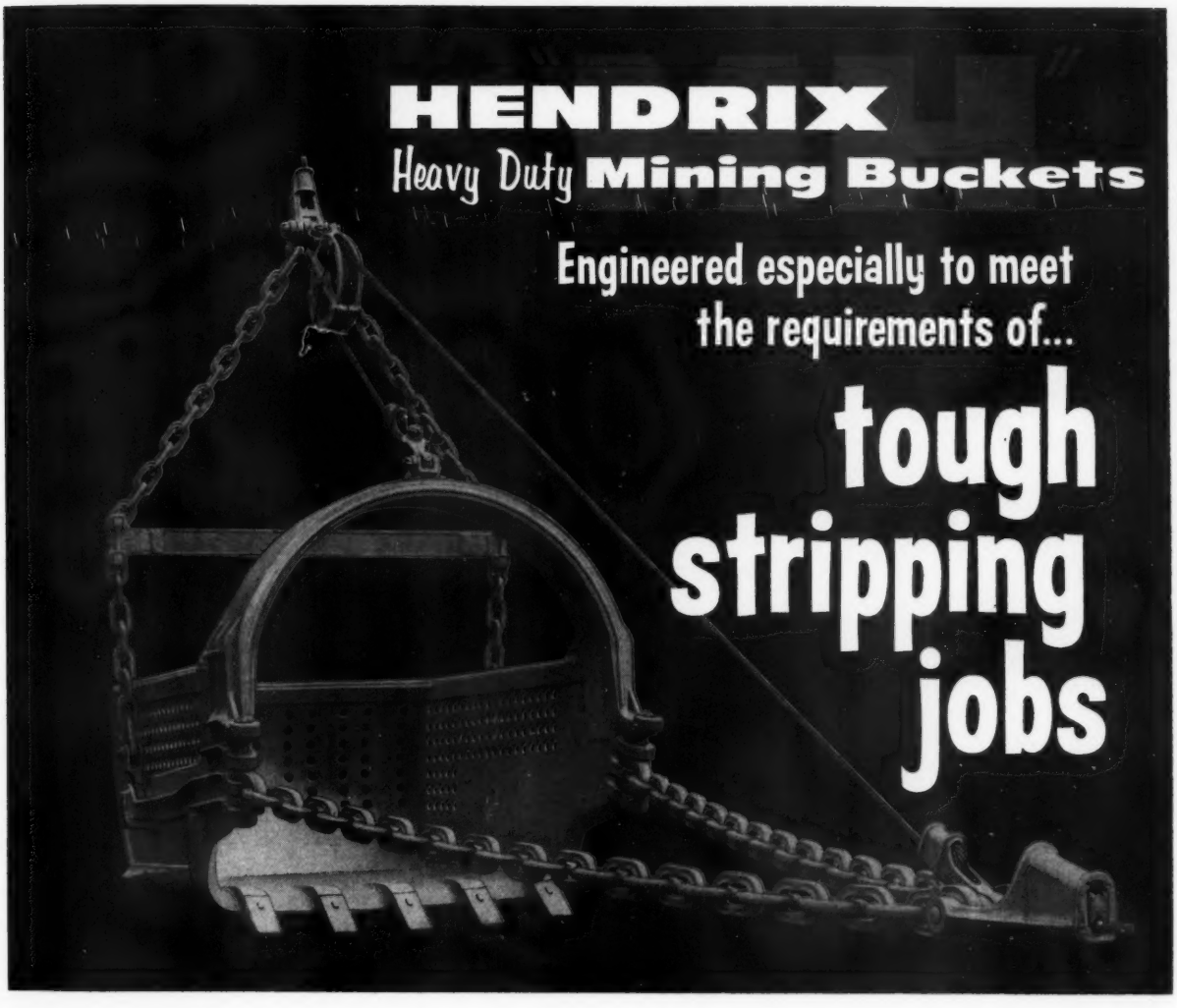

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**WRITE FOR BULLETIN 233-3**

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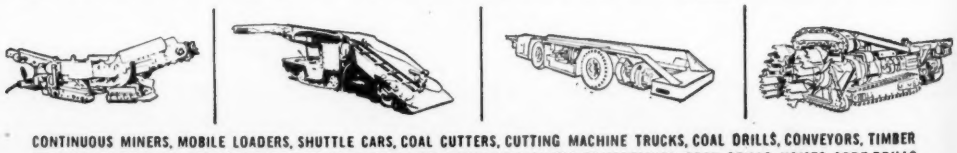

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# A Prediction of Future Demands in Coal Quality by the Electric Utility Industry

**Coal's number one customer will demand better prepared coal in the future as over-all operating efficiency rather than cost per ton becomes prime criteria**

By R. H. WOLIN
Assistant Chief Engineer
Combustion Engineering, Inc.

IN 1948 when the post war reheat unit was developed, utility companies went to single boiler, single turbine installations. Combustion Engineering, Inc., realized then that the advantages to be gained with reheat and higher pressures and temperatures would not be fully obtained by the utilities unless the steam generating units for these new conditions could be kept in operation. This factor of availability has since become tremendously important to the boiler designer and manufacturer.

Combustion Engineering has kept a record of 103 units which have been in service since 1949 through 1956. Figures for 1957 were not ready at the time of writing this article. As shown on figure 1, the average availability of the 103 units in service is 95.78 percent. Of the 4.22 percent of the time which the boiler was not available, 2.72 percent was for annual inspection. Less than one percent of outage time was caused by failure of or maintenance on pressure parts or fuel burning equipment.

It has been this kind of record which has made it feasible for electric utilities to go to very large units, and to tie up as much as 550,000 kw in one turbo-generator with the assurance that the machine will operate and that

**REHEAT**
**AVAILABILITY STUDY OF ALL PRIVATE UTILITY UNITS**

| | 1949 THRU 1956 |
|---|---|
| Number of Units | 103 |
| Total Capacity_Mw | 11,265 |
| Average Capacity per Unit_Mw | 109 |
| Total Boiler_Hours | 2,635,524 |
| " " _Years | 307 |
| AVERAGE AVAILABILITY | 95.78% |
| AVERAGE USE FACTOR | 90.40% |
| AVERAGE CAPACITY FACTOR | 89.60% |

PER CENT TOTAL HOURS IN OUTAGE

| | |
|---|---|
| INSPECTION | 2.72% |
| BOILER _ SUPERHEATER REHEATER _ ECONOMIZER DESUPERHEATER _ FUEL BURNING EQUIPMENT | 0.78% |
| AIRHEATER _ WASHING, ETC | 0.17% |
| (Auxiliary Equipment) VALVES _ FANS _ SOOT BLOWER _ MISCELLANEOUS | 0.55% |
| TOTAL | 4.22% |

| | |
|---|---|
| C-E Post War Reheat Units | 224 |
| Total Capacity_Mw | 32,010 |
| Average Capacity per Unit_Mw | 131 |

Fig. 1. The factor of availability has become of tremendous importance to the boiler designer and manufacturer. Note in the data presented here that less than one percent of outage time was caused by failure of or maintenance on pressure parts or fuel burning equipment. Of the 4.22 percent of the time which the boiler was not available, 2.72 percent was for annual inspection.

the power will be available when needed.

Figure 2 shows the increase in average throttle pressure in the years from 1948 to date. This average pressure has increased from about 1500 psig to over 2000 psig at the present time, with an indication that by 1960 this average pressure will go to about 2400 psig. The lower curve in figure 2 indicates that the utilities are holding back somewhat on increasing steam temperatures, the average actually dropping very slightly in the last few years. The attack on alloy tubing at high temperatures in superheaters and reheaters by sulphur, vanadium, and alkalies in fuels is one factor for this hesitation in adopting higher temperatures with their resultant gain in station heat rate. Another is the high price of alloy tubing suitable for 1050° F and higher steam temperatures.

## Components of Generating Unit Affected by Coal Quality

Every coal producer has some measure of control of the quality of his product. That is, he can, if it is economically advisable, eliminate part of the ash, the sulphur and the alkalies in it. Therefore, it should be of interest to coal men that in recent years an increasing amount of study has been undertaken by the utilities and, of course, the boiler manufacturers in the problem of coal quality and its effect upon steam generating equipment.

The following components of a steam generating unit are directly affected by coal quality.

1. **The size of each part of the unit—from the pulverizers and burners through the pressure parts, the heat recovery equipment, to the dust collectors and fans.**
2. **The operating and maintenance costs.**
3. **The efficiency of the unit.**
4. **The availability of the unit.**

Let us examine each of the above four items in some detail. Figure No. 3 shows a unit for the Will County Station of the Commonwealth Edison Co. This unit illustrates most features of modern boiler design.

## Size of Equipment

**Pulverizers.** Of course, the amount of ash in coal directly affects its heating value. Therefore, since the size of the pulverizers on a job is related to the heating value of the fuel to be used, this equipment gets larger and more expensive with low heating value coals than if these coals had been washed and their Btu value raised by removing some of the ash and clay.

**Furnace.** The furnace in a modern utility boiler is sized to properly burn the fuel, and to remove heat from the gas so that the temperature of the gas as it enters the convection surface area is low enough to prevent fouling of these surfaces and so that soot blowers can keep them clean. The boiler manufacturer limits furnace heat release rates according to the quality of the fuel. Coals throughout the country vary so much in ash fusion temperature and ash characteristics that the size of a furnace for a utility unit may be as much as 25 percent greater for some midwestern bituminous coals than for a good grade of eastern bituminous coal.

When water walls are covered with dry ash or slag, they absorb less heat from the furnace gas. Increasing the size of the furnace reduces the rate and the effect of fouling and lowers furnace exit gas temperature.

Any kind of washing generally reduces the alkali and iron content of coals. These two constituents have a direct bearing on slagging tendencies. Their reduction by washing, or any other method of cleaning, makes the coal easier to burn and, therefore, makes possible a smaller furnace.

**Superheater and Reheater.** As steam pressures and temperatures rise, larger amounts of these surfaces are required. Since they are the most expensive pressure parts used in a modern steam generating unit, effective use of their surfaces is necessary. The higher the gas velocity which can be used through them, giving higher heat transfer rates, the smaller the amount of surface that is needed. To prevent ash bridging in the convection surface at the furnace outlet when burning low ash fusion temperature, high ash coals, wide spaced surfaces must be used. This results in lower heat transfer rates. In the low temperature superheater section, velocities must be relatively low to prevent erosion from the ash. These velocities may vary from as high as 70 ft per second with low ash coals to 40 ft per second with coals having a high ash content. This tremendous difference materially increases the amount of heat transfer surface needed for the low velocity design and, of course, the price. This same velocity story is true for economizers which follow the low temperature superheaters.

**Air Heaters.** With the cost of fuel rising, a low exit gas temperature must be used to obtain high boiler efficiency. High sulphur coals require elaborate protective devices to avoid air heater plugging and corrosion. These devices, such as steam air heaters and hot air recirculating ducts, are expensive and their use diminishes to some extent the gain in efficiency obtained by going to low exit gas temperatures. Utility companies are now quite commonly using air heaters with exit gas temperatures as low as 250° F. Installations are being built where the stack gas temperature is taken down to 200° F, in an effort to gain efficiency. Gas at these temperatures approaches, or falls below, the dew point, and sulphur corrosion is quite common. Costly maintenance results unless special precautions are taken.

**After attending both the Polytechnic Institute of Brooklyn and Massachusetts Institute of Technology, R. H. Wolin went to the Detroit Edison Co. as a student engineer for two years. He joined Combustion Engineering, Inc., in 1939, and has been with the company in its Engineering Department ever since. He is now assistant chief engineer in charge of Proposition Engineering, and his department is responsible for equipment selection and design, performance calculations and guarantees, and proposition drawings.**

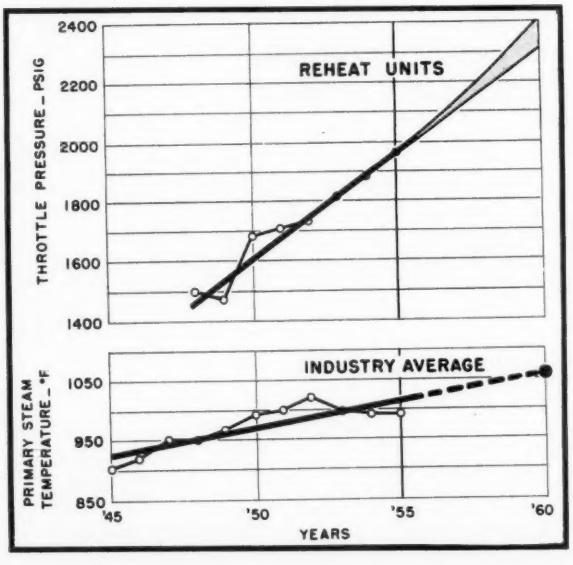


Fig. 2. Top curve shows the increase in average throttle pressure in the years 1948 to date. The lower curve indicates that the utilities are holding back somewhat on increasing steam pressures. The attack on alloy tubing at high temperatures in superheaters and reheaters by sulphur, vanadium and alkalies in fuels is one factor for this hesitation

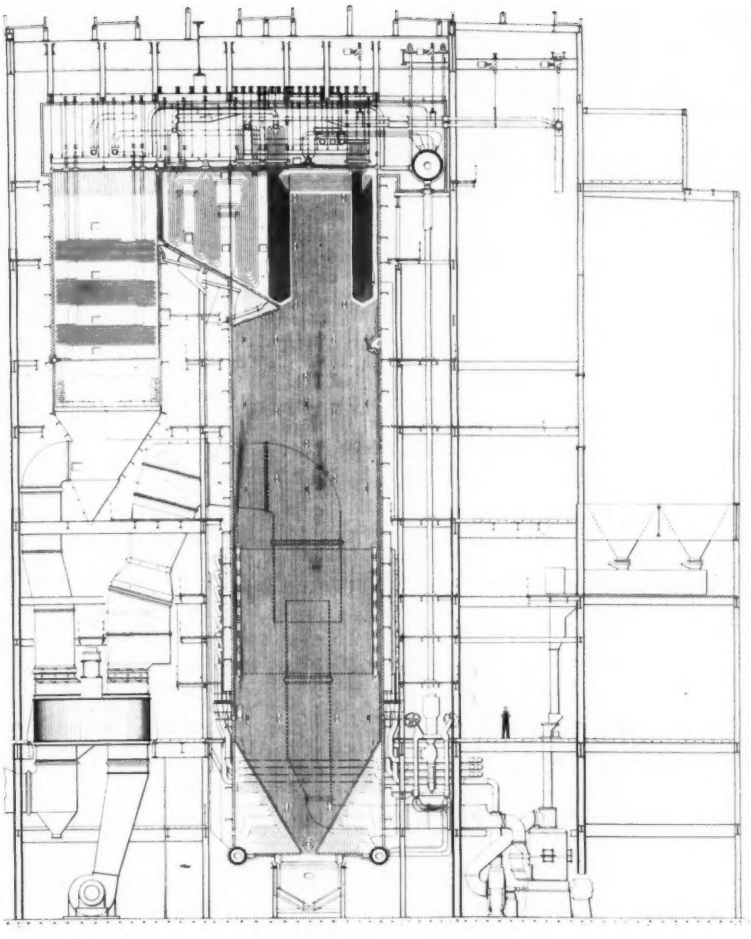
C-E CONTROLLED CIRCULATION TWIN-FURNACE BOILER
CAPACITY—1,600,000 LB PER HR AT 2100 PSI AND 1050 F TEMP.—REHEAT TO 1050 F
Designed and Built by COMBUSTION ENGINEERING, INC., New York

Fig. 3. Commonwealth Edison Company's Station No. 8, Unit No. 3, in Will County, Ill., illustrates most features of modern boiler design

All of this points to the value of removing sulphur from utility fuel.

**Dust Collectors.** The purpose of a dust collector is the reduction of stack fly ash emission to a low level, usually governed by ASME or local codes, and the minimizing of erosion maintenance on the induced-draft fan. The amount of ash in the coal directly affects the required efficiency of a dust collector, which in turn governs its size and price. Combinations of mechanical and electrostatic precipitators are being built with efficiencies as high as 98.5. These pieces of equipment—with their electrical connections, fly ash hoppers and valves, and ash removal piping—are highly expensive, and reduction in their cost can certainly be made possible by lowering the quantity of ash in the coal.

**Soot Blowers.** The kind of coal to be burned is an important index to the number of soot blowers to be installed on a modern reheat boiler. A large unit burning midwestern coals might require a soot blower installation costing $500,000, whereas a boiler of similar size burning a good eastern bituminous coal might have a satisfactory system at less than half of this price. Constituents in coal—ash, alkali and iron—all must be considered in determining how many and what type of soot blowers must be installed.

## Operating and Maintenance Costs

Costs of maintaining such items as pulverizers, soot blowers, fans, etc., vary considerably with different grades of fuels. A coal having a Hardgrove grindability of 80 will give a much lower maintenance cost in cents per ton than one having a grindability of 45. The frequency with which soot blowers must be operated depends upon the nature of the coal, and this frequency greatly affects their maintenance costs. The amount of steam or air required for soot blowing is a considerable item in the operating costs of a modern power plant. The removal of pyrites and slate from coal will help to reduce the operating and maintenance costs chargeable to any particular fuel.

## Availability

A large expensive steam generating unit and turbine combination is a loss to a utility when it is not operating, and high availability is something for which all utilities and manufacturers strive. The quality of the fuel to be burned is one of the greatest factors influencing availability of modern boilers. Excessive slag in the superheater and reheater, plugging of the openings at the bottom of the furnace and tube erosion are various elements causing shutdowns, in turn making the units unavailable for power generation. Obviously, the coals burned do have a decided influence upon these items.

## Efficiency

The higher the percentage of ash in a coal, the more excess air must be supplied to burn it to keep from slag in the furnace. This increases stack loss. Carbon losses are usually higher with higher ash coals. Some coals have inclusions which prevent operation with as low an exit gas temperature as the designer would like to use to get higher boiler efficiency.

## Blending May Be Necessary

Coal quality is falling off in many areas. For instance, combustion engineering has an installation soon to go on the line where the coal may have a sulphur content as high as 13 percent. The coal will normally be blended with a higher quality coal to bring sulphur content down to perhaps eight percent, as fired. The corrosive effect of this sulphur in the products of combustion on the superheater, reheater, and the air heater is something on which very little data is available. The unfortunate part of this case is that the coal seam was not found to be as low in quality as is presently indicated until after the boiler had been designed and partly constructed.

For best and most efficient steam generation, the operators of any large unit should know what coals are being burned all the time. Different coals require different amounts of air—including different burner and damper settings—more or less frequent use of soot blowers, etc., and coals which for one reason or another do not run uniform in a plant, lead to poor operation. This is a problem which plant owners must face when tremendous

quantities of coal are being brought into their systems. Combustion has obtained a contract for a 550,000-kw unit which will burn roughly 200 tons of coal, or four carloads, an hour. Because this coal will come from different seams and may have different burning characteristics, proper blending is essential to avoid operating difficulties.

### Operating Costs/Ton of Coal

Recently, some electric utilities have begun to look into the matter of total operating costs per ton of coal instead of just looking at the price per ton delivered to the plant. Surprising results have shown up in their studies when the investigations included such things as labor and power needed for cleaning units that are in service, amount of time and labor spent on cleaning units when they are down, maintenance and operating costs for different coals, the high cost of replacement power when a big unit is not available, the loss in capacity if units have to be down-rated for particular coals . . . when all these things and others are considered, a coal which is a few cents a ton cheaper delivered at the plant may prove many cents a ton more expensive. One such intensive study by a midwestern utility indicated that there was as much as $0.25 per ton difference between the operating cost of an average coal and the cost of one of their lowest grade coals . . . which was giving them considerable operating trouble. This $0.25 a ton represents five percent of the price of the coal, so large that they are not buying the poorer coal any more.

Adding chloride salts to coals in the wintertime to prevent freezing has for some coals an extremely bad effect upon slagging qualities. Other things could be added which will not give the slagging troubles experienced when a large amount of chlorides are present.

### Problems Increase as Pressure and Temperatures Go Up

The post war reheat units that went into service starting in 1950 have now had sufficient operating hours to give the utilities and the manufacturers important data on superheater and reheater tubing life at 1000° steam temperature and above.

One result of this experience is the following statement which Combustion Engineering now includes in its proposals:

"In the event that the equipment is designed for operation at or above 1000° F at the superheater or reheater outlet and the primary fuel is fuel oil or coal having an alkalinity of 0.4 percent or greater, Combustion Engineering, Inc., shall not be liable for failure of superheater or reheater tubing resulting from gas side corrosion, nor for deterioration of the spacers and supports of such tubing."

This is certainly a remarkable statement since it severely limits the responsibility of the boiler manufacturer for the life of the most vital and expensive parts of a modern steam generator, the superheater and reheater, when certain fuels are burned. An explanation is certainly due the reader on what has happened to make this statement necessary. Notice that the statement specifically lists "gas side corrosion." There have been other troubles with superheater and reheater surfaces, but it is felt that these can be, and are being, successfully designed out of new units. The attack, however, on alloy tubing by constituents in the fuels, over which the company has no control, when the alloy tubing must be operated at 1000° steam temperature is something that is not within our ability to design around at the present time.

To sum up, a large, expensive, efficient, steam generating unit is only as good as its availability. Its overall efficiency is greatly affected by operating and maintenance costs. The quality of the fuels burned has a great influence on these items. Utility and industrial companies are looking more and more closely into the over-all cost of coal in terms of cost per pound of steam generated rather than in cost per ton delivered to the plant. Therefore, it should be recognized that upgrading coals must be looked at more intensely by everyone concerned.

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## TWO SEAM STRIPPING AND PARTING REMOVAL

*(Continued from page 28)*

and type coal loader being used, the 45-ft cut works out ideally. A certain amount of spillage is experienced when a loader with a fixed rake angle on the dipper is loading No. 12 coal into the haulers on the No. 11 coal level. In order to minimize this spillage, Marion Power Shovel Co. has developed a variable rake angle dipper. The dipper adjusts to the proper rake angle for digging, then, when dumping, the dipper is adjusted through a control by the operator to the proper angle for low dumping. Afterwards, of course, the rake angle is reset for digging.

The rating of the tipple is 800 tph from the pit and 600 tph from the storage bin, a total of 1400 tph of prepared coal through the plant. Facilities permit shipping cleaned coal either by rail or by water. The loading dock for water shipments will hold eight barges of approximately 1500 tons capacity each. Thirty 100-ton capacity hopper cars and one 1200-hp diesel electric locomotive shuttle the coal from the tipple to the dock over a 6½-mile track.

Dock facilities will hold eight barges of approximately 1500-tons capacity each

# ORGANIZATION FOR EXPLORATION

**The geology department's problem in a small mining company is to duplicate the broad services rendered by the fully-staffed exploration department of their large competitors**

By JAMES P. POLLOCK
Chief Geologist
Calumet & Hecla, Inc.

THE organization of a mining company for exploration is, in effect, organization for survival for, as we all appreciate, any deposit of natural substances is a wasting asset. Exploration must be conducted at existing properties to replace exhausted reserves and any company desiring continued life or expansion, of necessity, is forced to look both near and far afield. In most companies, at a mining property, there exists a mining and engineering staff which is technically capable of handling the operation of additional properties, or which can act as a reservoir of skilled key personnel to be transferred to some other successful exploration. This gives an existing organization a considerable advantage over one which is attempting to enter the field anew and exploration can aid in the most effective utilization of these intangible company assets.

Originally, exploration was handled solely by the mining engineer. In the early days properties were generally found by prospectors with little technical knowledge; called to the attention of a mining company, and these deposits were then explored under the supervision of mining engineers. Properties which were explored were those at which commercial values outcropped or were near the surface, and incorporating structures which were fairly simple in nature. The basic problem was sampling and estimation of ore reserves, not discovery. Geological services were generally rendered, where necessary, by consultants; usually men attached to geological departments of an educational institution. As the need developed for day-to-day mine mapping, and partially under the influence of apex suits, geologists came to be added as members of the staff of an existing mine. As a result, the geologist has been, for many years, a recognized member of a well-organized mine staff.

It is repeating the obvious to say that during the passage of years most conspicuous deposits have been explored and that at the present time discovery is the basic problem. Increasingly we are searching for ore at greater depths and in structures partially concealed, or even totally concealed by later rocks or alluvium. The tools utilized in exploration, such as aerial photography, geochemistry, geophysics, and structural analysis, have all increased in complexity to a point where many companies engaged in exploration have organized exploration departments more or less distinct from those resident geological departments utilized in the search for ore at an existing property.

## Small Companies Must Be Selective

Exploration staffs in a large company may include highly specialized men, and in addition to field geologists, geophysicists and even geochemists, may be found as permanent members of the staff. Speaking from the viewpoint of a small mining company attempting to survive in the keenly competitive exploration field, the problem is to duplicate the services rendered by these large staffs by a comparatively small group. While the large organization may be successful by engaging in a large number of exploration ventures, widely scattered geographically, hoping that some of these will prove successful and repay their efforts, it is the author's firm conviction that success for a small company lies in selectivity.

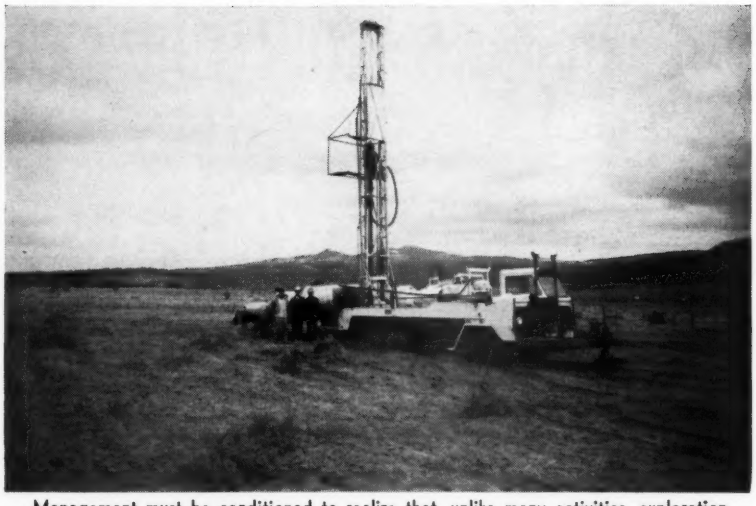
Selectivity starts first with the nature of the raw material for which one proposes to search. For a company engaged, say, in the fabrication of copper finished products, exploration for copper is one obvious field. Controlling the production of raw materials affords the fabricating department a sure source of copper in times of scarcity, and the fabricating department affords the copper production end an assured market in times of abundance of copper. The tendency to vertical integration of larger companies is, of course, well developed. An example of selecting a field of activity in the case of Calumet & Hecla, is the decision reached several years ago to make a major effort in the field of uranium exploration. This decision was preceded by an extremely careful study of the nature of the uranium market, the effect of government price guarantees and incentives to production, possible utilization of government technical help, financing through the DMEA for exploration; as well as the size of the ore bodies being found, capital requirements for equipping a presumed ore body for production and probable return on investment—assuming a successful exploration program. In the

case of uranium, it is of little significance that the company is not a user of uranium metal since a ready guaranteed market is presently available through the Atomic Energy Commission.

A similar analysis conducted, say, of the taconite industry from the company's point of view, would show that the capital requirements were beyond its present resources, the technical problems involved in beneficiating taconite were such that it would take considerable study and training of the organization to be able to cope with these problems, and that the company would be dependent upon other organizations as an outlet for the finished production. These unfavorable factors strongly militate against Calumet & Hecla's activity in the taconite field. For a slightly different situation if production of bauxite were considered, a technical staff capable of handling all phases of production of bauxite is available. However, examining the markets for the crude ore, it is seen that a large part of the potential market consists of companies of large size, already possessing substantial deposits of their own, engaged in aluminum fabrication. It is extremely doubtful if such users would be interested in acquisition of raw materials from other sources, or if they would pay any great premium for this privilege. A potential outlet might exist in the aluminum chemical industry or abrasive field in conjunction with a company desiring a source of raw materials, and under such special circumstances bauxite production might be attractive; these superficial reviews are mentioned merely to illustrate some of the factors that should be considered in the selection of the field of raw material production on the part of any company hoping to successfully enter the field. The attitudes of each company towards the type of factors mentioned will vary, of course.

## Management Must Direct Exploration Department Policy

It will readily be seen that the majority of the questions dealing with selection of the field of interest involve policy decisions at the top level of management, and this leads us to the consideration of management as the basic factor in organization for exploration. Management must be willing to accept the responsibility for giving policy direction to the exploration department (aided, of course, by the geologic staff in reaching decisions) and must have something more than an undirected desire to make money in the field of raw materials. In fact, education of management in thinking along exploration and geologic lines is a major problem in setting up the basis for a sound geologic organization. Management must be conditioned to realize that, unlike many activities, exploration is one in which frequent failures must be expected and accepted. Not every prospect explored becomes a mine and there are many drill holes aimed at postulated ore targets which are disappointing.



Management must be conditioned to realize that, unlike many activities, exploration is one in which frequent failure must be expected and accepted. (Pictured is an exploration drill, owned and operated by Tulsa Drilling Co., in service for the exploration department of Calumet & Hecla, Inc.)

The finance group must accept the fact that they will have to underwrite programs which may not be productive for a number of years. They must also recognize that exploration is one of the costs of doing business and that not all the depletion allowances can be diverted for the purpose of internal cash generation. In a small company, the close personal contact possible with top management can be a major factor in the success of an exploration organization. The geologic staff must be permitted to voice its problems and to make its recommendations heard.

## Responsibilities of Chief Geologist Should Be Clearly Defined

These considerations lead to the first job in an exploration organization: that of the Chief Geologist or Director of Exploration, who must act as the voice of the exploration staff. The nature of the duties of the Chief Geologist should be clearly set forth in a position description or outline of responsibilities so that management may realize what they can expect from the man, and the man can measure himself and see if he is living up to the responsibilities with which he has been charged. The position of the Chief Geologist generally has both line and staff functions; it has primary line responsibility for the planning, recommendation and direction of geological exploration and appraisal of the results. Concerning management, the Chief Geologist will have staff responsibility in a consulting and advisory capacity in problems such as mine development work and selection of fields of endeavor.

In addition to a comprehensive knowledge of his own field, he must have a good background in mine methods and practices, a thorough understanding of the corporate structure and the responsibility of the geological department in that organization, and sufficient business background to appraise the economic factors involved in exploration. In a small group, further training of field men of Senior Geologist status might well be a duty of the Chief Geologist. The Chief Geologist must work with the controller or financial officer in budgeting exploration expenditures and in developing an accounting system which will permit control of the costs of exploration in any one area, or portion of that area, whereby the results of an exploration program can be assessed by management and by the Chief Geologist. This accounting system must be so set up that it can give management a correct figure for the cost of discovery per ton of ore.

In the annual budget the Chief Geologist must forecast the exploration work he will recommend in the ensuing year. A cost estimate must be prepared for this work which, in some cases, is merely an educated guess, while in others it can be forecast with considerable accuracy. Approval by management of this budget implies acceptance of the program submitted and the intention to carry it out to the extent that funds are available. The budget is a device of considerable utility which imposes upon the Chief Geologist the mental discipline of re-

view of the entire company exploration picture, and of weighing the relative merits of various programs. It is not a blank check on the company treasury as each project must be later justified by an analysis which accompanies an appropriation request. The annual budget also advises the financial people of the requirements for funds of the geological department for the ensuing year and is brought up to date by a running forecast of expenditures by quarters for a year's period.

Once the general field has been selected by management, it becomes the responsibility of the Chief Geologist to select the areas in which search will be conducted. For purposes here, this can be boiled down to a quotation of the familiar saying "If you want to hunt elephants, go to elephant country." While it is possible from a centrally located area to send out parties for detailed examination of previously selected locations, the system used by many oil companies has a great deal to recommend it. Under this system, a district is set up which may consist of one or two states, or more as the case may be, establishing a party in that district under a District Geologist or Chief of Party. This has the advantage of allowing the man in that party to become familiar with local geology, to get to know their competitors and "swap" information. Operations near his home introduce a factor of stability in the family life of a geologist, which is to be highly desired as a means of attracting and keeping good field personnel. The units with which the Chief Geologist works, therefore, are field parties for those districts in which he proposes to do exploration.

## Factors in Selection of Area for Study Vary Greatly

The composition of a field party may vary depending upon the raw material being sought and the area in which that search is being carried on. To illustrate this, let us suppose that a management decision has been made to expand copper production. The Chief Geologist decides that the most attractive possibility is to try and find a porphyry copper, and sells this idea to management. Study of the existing porphyry coppers shows that in a broad way a number of the porphyry copper deposits have been found in districts of the southwestern U. S. such as Santa Rita, N. M. Here a central intrusive complex, in which the porphyry copper is located, has been zonally surrounded by lead-zinc replacement ore bodies peripheral to the copper deposit in favorable limestone horizons. The decision is reached by the Chief Geologist that an attempt will be made to find an unrecognized or concealed porphyry copper by a study of districts where there are known intrusive complexes, but only the peripheral lead-zinc mineralization has been recognized. This is, of course, merely a highly abbreviated version of the concept. A project of this type requires detailed library research coupled with field visits to selected areas which appear to meet the criteria established. Once a promising area is found, broad geologic mapping might be indicated as well as study of alteration patterns, etc. This might lead to geophysical study to sharpen the target area. The course of study would be one of long term without particular pressure from competition except from field parties similarly engaged. The emphasis is on an almost scholarly or academic study of porphyry copper geology.

At the other end of the spectrum would be exploration activity such as that in the uranium field when speculation was at its height. Here there was little time for leisurely field studies. The emphasis was on acquisition of ground in supposedly favorable areas under active competition from many sources including established mining companies, oil companies, and small uranium companies or promoters. A wide range of opinion existed as to what was an acceptable risk among these groups and to some the question of risk was even immaterial and competition for ground was paramount. Guides to ore were questionable and few. The degree of wildcat drilling was high and things had a slightly frenetic air.

It will be clear that the make-up of field parties will differ both as to the type of training and background the men possess and also the temperament of the men in the party. A man mentally equipped to follow a long program of careful study of alteration patterns with energy and enthusiasm might have difficulty in adapting himself to a uranium boom camp where a situation refuses to stand still long enough to be analyzed. Likewise, a geologist or even chief of party might find academic background of secondary importance in uranium explorations, while such qualities as personality and mental agility would predominate.

Recognizing then the broad variations which may occur depending on objective, the composition of a field party best equipped to carry out the management policies and objectives can be interpreted by the Chief Geologist. As background for the structure of the field party there should be a clear position description for each job; clear reporting relationships must be established, and lines of authority defined. This may seem superfluous, but in an active exploration picture where assignments may be shifted at frequent intervals it is a real problem.

## Chief of Party Has Many Important Duties

The leader of the field group should report to the Chief Geologist. He may have functional relationships to operating personnel. The administration of the field party is under his direct supervision. His duties are to organize and supervise the exploration staff, drillers, mining contractors and engineering assistants. He should upgrade personnel by training where necessary. He must examine and evaluate properties, aid in the acquisition of land, develop the routines for drilling, logging, sampling, surveying, map preparation, etc. and supervise the work. Cost estimates for drilling and exploratory mining operations must be prepared by the Chief of Party, and he, of course, supervises this work. He must keep abreast of developments in his area and keep his superiors advised of situations affecting the company interest. A host of minor additional duties may appear on his job description such as supervision of payrolls, preparation of reports, etc. A minor but important amount of his time will be spent acting as chaplain for his party or recipient of various gripes and grievances. This duty will probably not appear on his job description.

Obviously, a man charged with these many tasks must have capable assistants to whom he may delegate some of these tasks. Again their duties should be clearly set forth in job descriptions and lines of authority clearly understood to prevent possible friction. While the duties of Chief Geologist and Chief of Party have been given in considerable detail, those of his subordinates can be more easily discussed from the viewpoint of the functions which they perform. Every exploration project passes through various stages and the number of assistants and their duties will vary according to the phase. In small parties, men have to be willing to double in brass and assume a variety of tasks according to circumstances.

## Acquisition Period May Require Land Man

During the initial study of the area and development of the concept or basic idea, duties will be primarily geologic in nature and one or more geologists will be required for assistance. Once some geologic basis for selection of land exists, the exploration enters the acquisition phase. Even where some techniques such as aerial magnetic or electromagnetic surveys are used to locate interesting anomalies, ultimately a point is reached where land must be acquired to permit detailed ground geophysical and geologic study.

With the increase in exploration of deep targets or of objectives covered

by later rocks, the areas which it is necessary to control have increased in size. No one likes to do exploration which proves to be of benefit largely to the owner of adjoining property. In the uranium field, for example, with generally small erratic and scattered ore bodies, control of a sizable area is essential. One project may cover Indian tribal land, Indian allotments, public domain, homesteads of various types, and Spanish land grants. Where mining companies once were concerned with fractions between poorly located claims as their most complex problem, they now have to cope with a wide variety of land situations.

Legal advice is necessary on a consulting basis generally, but a land man is the key figure in the acquisition period. It is his responsibility to be familiar with all the technicalities governing these varieties of ownership, and to establish a system for keeping track of the obligations for lease payments, minimum royalties, and assessment work. Because of past experience in acquiring large tracts of land, oil companies have developed utilization of a land man to a higher degree than have mining companies.

### Exploration Department Duties Cease After Appraisal

Concerning the next phase of exploration, the actual testing of ground by drilling or underground work, the men required are geologists and mining engineers. One thing which has impressed the author recently is the success the company has had in training energetic and willing people of no technical background to carry out some of the more readily delegated duties of the technician.

In the final step, appraisal of results, the all too frequent failures are readily disposed of. In the event a worthwhile discovery has been made, ore reserves must be prepared. At this point the Chief Geologist and Chief of Party must work with the operations department in determining such factors as mining method, dilution factor, minimum mining thickness, so that the final estimate will be one which the mining department can accept as a basis for estimating capital expenditures and financial outcome. At the point at which the ore reserve is accepted by the mining department, the responsibility of the exploration department ceases.

The author has outlined the basis for selection of a field and for choice of exploration targets in that field, and detailed such a well-organized and trained staff that they cannot fail. However, no doubt he will pick up tomorrow's paper and read that the outstanding uranium discovery of the year has been made by a chiropractor while on a Sunday picnic.

Energetic and willing people with no technical background can be successfully trained to carry out some of the duties of the technician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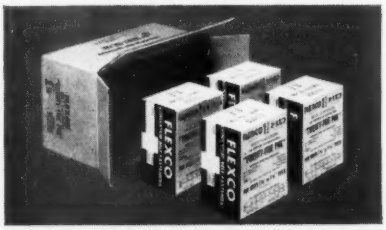

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FOR THE SPLICE OF A LIFETIME

# Rock Dusting in Multiple-Shift Operations

**Every engineering advance in productivity must be accompanied by a greater advance in engineered safety if the hazard of dust explosions is to be decreased**

By C. E. LINKOUS
Director of Safety,
Island Creek Coal Co.

SINCE the explosion hazard of excessive coal dust accumulation in mines has been recognized for several years and everyone accepts rock dusting as a necessity in bituminous coal mines, it is not necessary to sell anyone on the need for such a program regardless of the cost.

This being true, a rock dusting program requiring several main items must be accepted. First is the objective—to dilute with an inert material the coal dust so that it will not enter into an explosion in the event it is accidentially thrown into suspension in the presence of an igniting agent; (2) the motive is to reduce, if not eliminate entirely, the possibility of an explosion which would take the lives of many of our valuable employes and, also, to comply with the standards of the various state mining departments and the provisions of the Federal Law as to minimum requirements; (3) procedure—the application of rock dust must be scheduled and no interruptions can be permitted to cause a departure from or neglect of this prearranged schedule and this, by necessity, requires continuous checks by the personnel of the company safety department to assure that rock dusting is adequate as to quality, quantity and timing of application, and (4) provisions for adequate machines, rock dusting crews and an ample supply of rock dust available at convenient locations throughout the mine. These are all *musts*.

The physical hazards of the coal industry are potentially greater than ever before. Workings are more concentrated and machines and methods are designed primarily to produce more coal from fewer active working places.

Every advance in productivity which is achieved by engineering genius must be at least matched by safety engineering and protective procedures in the mines and cleaning plants if coal dust explosions are to be avoided. At the present time, dust application is carried out by three different methods. Hand dusting, although still practiced to a large extent, is slow and therefore costly. Machine dusting with a conventional distributor which applies the dust dry is the most widely used method and is cheapest from both the quantity of dust required for full protection and the cost of application. The third method is to apply the dust in a slurry form on shift without interrupting regular operations.

**C. E. Linkous' early experience included four years as a State mine inspector, both in Virginia and at Wheelwright, Ky., and seven years in the Operating Department of Inland Steel Co. In 1938 he was appointed State mine inspector in Kentucky and served in this capacity until 1941 when he became a Federal mine inspector. He was with the U. S. Bureau of Mines until the latter part of 1947. In December of that year he joined Island Creek Coal Co. and is now director of safety.**

## Rapid Advance Increases Problem

The method of rock dusting in multiple-shift operations is affected by number of shifts (two or three) and the type of mining (off-track, track, conveyor or continuous mining).

Rock dusting is greatly simplified in double-shift operations, except for the hand dusting of crosscuts which hole through during the production shift, as a high-pressure machine is used to apply the rock dust on the off-shift. The real problem is presented by triple-shifted sections and mines and/or where the face or faces advance more than 40 ft. in two consecutive coal producing shifts. This problem is particularly acute where continuous mining machines are used.

At the present time Island Creek Coal Co. is operating 17 mines in ten different seams. Coal thickness ranges from 29 to 90 in., with the majority of these mines operating in coal heights of 29 to 54 in. Naturally, rock dusting is slower and more difficult in thin seams where conveyors are used.

At the present time, Island Creek has only one large mine which is completely triple-shifted. Other triple-shift operations are limited to one, two or three sections in other mines. Except for one all-track operation, these mines utilize mobile off-track equipment and/or conveyors.

Four cases of multiple-shift operations are cited to show how rock dusting is being handled in all-track, off-track, conveyor and continuous mining sections.

## All-Track Mine Uses Two Methods of Dusting

This all-track operation uses modern mobile loading machines discharging directly into mine cars. Double-shifted, the mine is operated five days a week. Each working place is rock dusted two to three times a week with a high-pressure track-mounted machine. This is augmented by hand dusting each shift with two 80-lb. bags of rock dust for each cut of coal that is removed. Places are usually kept dusted to within four cuts (32 ft) of the face. All crosscuts that are driven through are rock dusted in the same manner. The plan has proven very satisfactory as two cleaners are employed on each section, each shift to properly clean all

loose coal and coal dust immediately prior to the hand dusting. It is the immediate supervisor's responsibility to see that both cleaning and hand-dusting are done according to the company plan, even though it may, at times, tend to retard other phases of operation.

Generalized rock dusting of haulage roads and intake and return airways is done on idle days and/or week ends. Stoppings are equipped with pipes and by removing the cap, the hose can be either passed through the pipe or connected to it, at the stopping, thus making it convenient to adequately redust back entries when and where necessary.

Haulage roads and parallel entries connected by open crosscuts are recoated at least four times a year.

### Skid-Mounted Rock Duster Transported in Shuttle Car

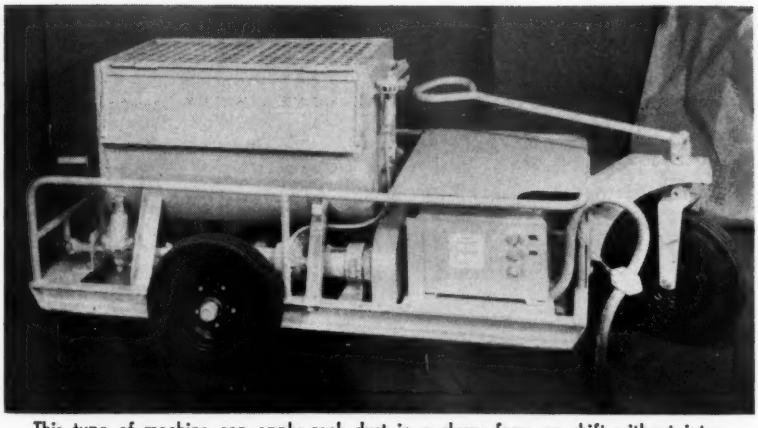
The second mine to be considered operates in a 41-in. coal seam and uses off-track equipment, with shuttle cars hauling to an elevator where mine cars are loaded on a track loop.

Except for providing a Bantam 400 rock-duster on each of the six sections, the method of rock dusting is the same as at the preceding mine.

Rock dusting, either by hand or machine, is preceded by loading out the spillage from the last open crosscut to the face. This is done as the loader enters the place, between shuttle car changes and when there is any idle time during the shift. Line timbers limit the amount of cleaning that can be done in this manner, so, any member of the operating crew that can be spared for short periods of time during the shift are used to turn the loose coal out to where it can be picked up by the loading machine. This not only reduces the danger of an excess accumulation of coal dust but also reduces the amount of rock dust required.

**IMPORTANT MUSTS FOR A GOOD ROCK DUSTING PROGRAM**

1. **Top management must desire safe operations.**
2. **Equipment and crews and a supply of rock dust at convenient locations are a must.**
3. **There must be a definite plan.**
4. **Each supervisor and each mine worker, who is to perform the work, must be familiar with the plan and strictly adhere to same.**
5. **A continuous check must be made by company safety personnel to assure that rock dusting is being carried on according to plan.**
6. **Adequate rock dusting and/or safe operation of a mine is the responsibility of local management and it must, by necessity, take a personal interest in, and devote considerable time to, this phase of modern coal mining.**



This type of machine can apply rock dust in a slurry form on shift without interrupting regular operations

Rock dust is delivered to the loading point in each section, and the rock duster and hose are kept as near the working face as possible. Rock dusting crews travel to the sections on "jeeps" or locomotives, making it possible for a two-man crew to dust 2 to 2½ sections each shift.

These men place their skid-mounted machine inside the cable-reel shuttle car, along with their supply of rock dust. They then make a tour of all working places and rock dust the exposed area, which has been previously cleaned and hand-dusted. Supplemental dusting is done when the track is extended and the section is moved up.

In dusting a section in this manner, the shuttle car is stationed on the intake side at a convenient location and one man handles the 50-ft section of hose while the other feeds the dust from the *stationary* shuttle car.

### Low Coal Operation

Height of the coal in this mine, number three, is 31 in. Chain conveyors are used in the working places to transport coal from the mobile loading machines to a belt conveyor which, in turn, discharges the coal into mine cars along the main entries.

Two 50-lb bags of rock dust are applied by hand after each cut is removed. In addition, at least twice each week, the two places, which constitute a working section, are redusted by a small skid-mounted machine which is dragged by hand. This is usually done on the third or idle shift. However, if faces advance 40 ft and/or conditions warrant, this area is dusted near the end of the production shift.

Since both West Virginia and Kentucky laws require belt conveyors to be ventilated with a minimum separate air current, it is possible to rock dust belt entries while preventive maintenance or other general work is being carried on in the working section.

The usual practice is to load bags of rock dust on the belt at five to ten-ft intervals. The duster is pulled by hand, alongside the belt, and the dust is removed from the stationary belt as needed. Either an electrically operated machine or an air machine connected directly to the airline for roof-bolting machine can be used to distribute the rock dust.

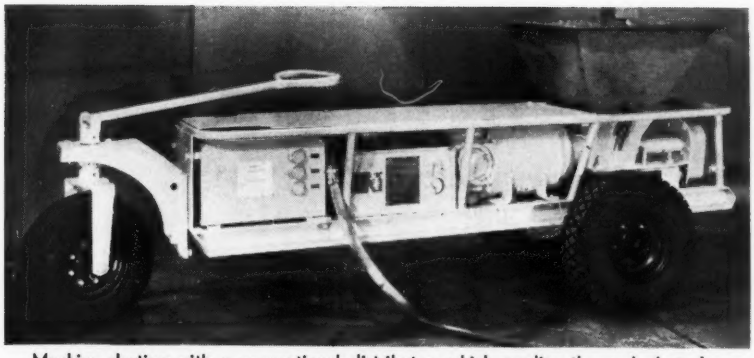
Since rooms are driven on retreat and pillars are not recovered, very little rock dusting, other than hand dusting when chain lines are removed, is necessary inby the end of the belt.

### Triple-Shift Operation Poses Rock Dusting Problem

Our fourth example is a triple-shift operation where high capacity continuous mining machines are used in some sections for developing and off-track equipment is used in the remainder of the mine. Thus, the 40-ft limit is reached several times during a shift, where the continuous mining machines operate, and at least twice a day (three shifts) in mobile sections using off-track equipment with shuttle cars.

The setup certainly creates a rock dusting problem. Heretofore, hand dusting was the only solution when the place or places advanced more than 40 ft, and this did not prove very satisfactory as in many instances the floor behind the continuous mining machine was being used as a surge bin. In this case the continuous unit was backed up by a loading machine and shuttle cars. In other sections a Piggyback conveyor was used to load into a chain line or the machine discharged directly onto an extensible belt. Thus, the entire coal output was contaminated and most of the rock dust was loaded out with the coal.

It became necessary to do one of two things: Either leave two men on the section to rock dust between shift



Machine dusting with a conventional distributor, which applies the rock dust dry, is the most widely used method of dust application. It is cheapest as to both the quantity of dust required for full protection and the cost of application

changes, at overtime rates; or apply wet rock dust on shift.

At present there are at least two methods of applying wet rock dust or slurry to the ribs during a working shift and as the faces advance. One method is to use a gunite-type nozzle, which is fastened to the end of the discharge hose of any high-pressure rock duster, and a water hose equipped with a valve to regulate the flow and obtain the power mixture. In this case the dust is mixed with water at the nozzle discharge.

The other method is to mix the water and rock dust, either manually or mechanically, in a container before it is applied.

Where the gunite-nozzle method is employed, the equipment used is generally rubber-tired mounted or off-track Bantam rock dusting machine using a section of two in. rock dusting hose, and a ⅝-in. water hose with with a minimum of 150 lb water pressure. As the air-borne dust passes through the nozzle a series of orifices in a water ring introduces a fine spray of water into the air dust stream. The operator controls the amount of water used so as to have the mixture discharged as a slurry. The use of six to seven gal of water is recommended for each 100 lb of rock dust.

The rate of evaporation from wet rock dusted surfaces depends on the humidity in the mine atmosphere. Tests have shown that it takes anywhere from four to five days for the moisture to evaporate from the slurry applied to the ribs and roof. In the meantime, dry rock dust is applied by hand to the roadways.

## "Home-Made" Machine Dusts Places in Three Minutes

Through the ingenuity of a mine superintendent, a wet rock duster has been built in the local mine shop for use in a triple-shifted shuttle-car section. This unit is mounted on the roof-bolting machine and is powered by a small fluid motor driven by the hydraulic system of the roof-bolting machine. The fluid motor drives a small slurry pump which supplies the water and rock dust mixture. This mixture —one 80 lb bag of rock dust and six gal of water (mixture) per cut of coal—is applied in cycle by one member of the roof bolting crew.

Usually it is the third or fourth cut, from the face, that is dusted each time the bolting crew enters the place. From observation, the bolting operation is not interfered with when the place is being wet dusted.

Studies have shown the time required to wet dust a place to be as follows:

| | |
|---|---|
| Fill tank with water to mark | 0.55 minutes |
| Put one 80-lb bag of dust in tank | 0.50 minutes |
| Turn paddle-agitator manually to mix | 0.60 minutes |
| Start pump and spray on roof and ribs | 0.75 minutes |
| Total Time | 2.40 minutes |

With a maximum of 3.0 minutes needed to wet rock dust a place, and a minimum of 15 minutes required to bolt a place, 12 minutes are left for the man who applies the slurry to perform his usual duties such as setting safety jacks, assembling six bolts, making bit changes, taking care of trailing cable and hose and assisting with the tightening of bolts.

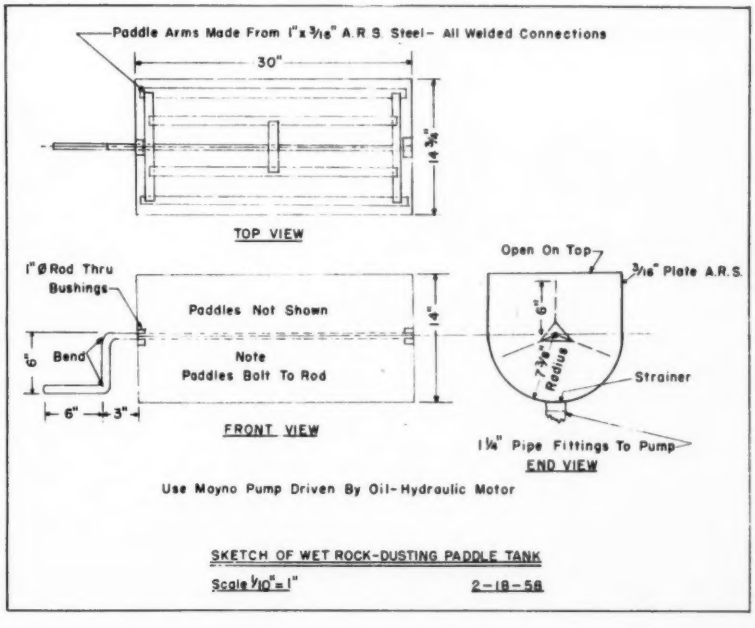
The accompanying sketch shows three views of the mixing tank which is supported directly over the fluid motor and slurry pump. The system is considered very efficient and simple, and is expected to require low maintenance. The one-bag batch, sufficient for one cut of coal, is easy to mix manually. The effectiveness of applying the rock dust is considered comparable to the more expensive type employing automatic mixing with air pressure of 125 psi.

Following is a breakdown of the cost of this unit as furnished by the maintenance foreman. All material and labor were current prices and rates at time of assembly.

| | |
|---|---|
| Material for tank | $ 18.74 |
| Slurry pump | 198.00 |
| Fluid-drive motor | 125.00 |
| Shop labor (2M.D. @ $23.88) | 47.76 |
| Total Cost of Unit | $389.50 |

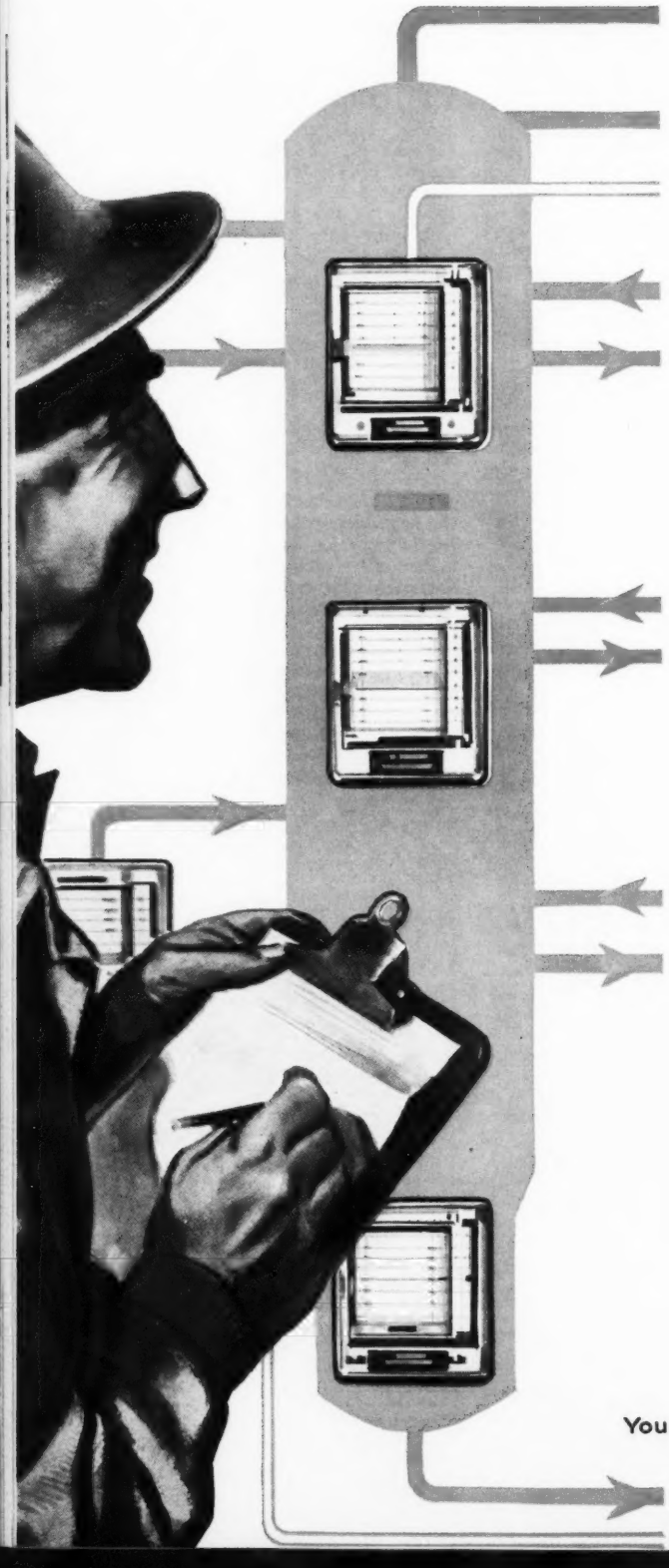
It is the considered judgment of the mine superintendent that the saving in overtime—two men would have to be left for more than an hour to dry rock dust following each shift—paid for his wet rock duster in 12 working days.

The quantity of rock dust used at all Island Creek mines during 1957 was about 80,000,000 lb or 5.90 lb per ton of coal mines. Individual mines ranged from 4.0 to 12.08 lb per ton of coal.



# Nothing gets by

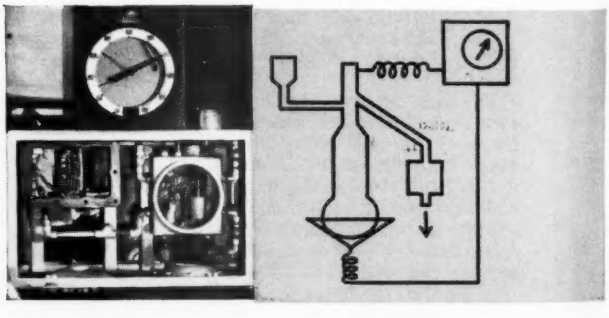
## Automatic end-point testing device developed by Standard Oil research men makes certain of the uniform quality of gasoline and diesel fuel delivered to you.



Scientists at Standard Oil never stop in their drive to improve and then improve again the uniform quality of the petroleum products that bear the Standard Oil trade-mark. These engineering research scientists have now created wholly new instruments for performing near continuous physical analysis *automatically*.

**One such instrument** automatically performs the physical analysis that determines end-point. Using it, refineries maintain a continuous inspection of the temperature at which gasoline and diesel fuels are completely distilled. To you, this means that Standard is able to maintain a constant control over the uniformity and high quality of the gasoline and diesel fuels you use. It also means that Standard Oil power-producing petroleum products, with their constantly controlled end-point, burn uniformly, give you uniform high performance.

This is part of the research pay-out, the "something more" research builds into the products you buy from Standard. This is your return from Standard's investment in research. And now there are 48 district offices in the 15 Midwest and Rocky Mountain states to serve you. Call the one nearest you. **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



Automatic end-point tester works this way. A small sample is placed in an electrically heated flask. The temperature is measured and recorded during a heating cycle when distillation is accomplished. Distillate is condensed and drained, the flask temperature is lowered by introduction of the next sample, and the apparatus is ready for another test.

You expect more from STANDARD and get it!

# Drill Steel Developments in the Laboratory

## Most progress thus far has been related to mechanical rather than metallurgical research

By FLOYD R. ANDERSON
Assistant Manager
Gardner-Denver Co.
Denver, Colo.

FROM the time some 50 years ago when hollow staybolt iron was used for mining drill steel, advances in drill steel have developed partly by accidental discovery, partly by planned intent. The change from low carbon iron to high carbon steel was dictated by the need for a highly hardenable steel for the integral bit cutting edge. The sand core product met the need for a heavy walled tube in high carbon steel. Steel rolled on a metal mandrel was a long step forward because the tube hole pits of the sand core steel were minimized. High carbon alloy was born of the desire to eliminate shank treatment in stoper steels because the as-rolled hardness was equal to that obtainable by oil hardening carbon steels. A by-product of development of this air hardening material was quite accidental and, for many years, unrecognized. The low carbon alloy rod came from what was believed a prime need; for example, a material which by no means could be hardened to a value in excess of that embodied in the piston hammer striking end. While this was commendable, it was made possible only by the advent of the detachable bit whose cutting ability was divorced completely from the properties of the drill steel. During this period of some 30 years of development, metallurgists were discovering the evils of metallurgical notches, decarburization, corrosion fatigue, overheating, and overquenching. In fact, poor indeed were the resources of the laboratory incapable of pointing an accusing finger at some cause for any type of shortcoming in drill steel performance.

### Carbide Bits Point Up Shortcomings

It remained for the Germans to prove that tungsten carbide inserts could cut and crush rock without being shattered into nothingness. When carbide bits, capable of hundreds of feet of drilling, took the place of the steel bits drilling only several feet, then, and only then, were the inadequacies of drill steel exposed.

Steel was then expected to match bit performance. Long hole drilling, with its demands on steel, was made possible by these bits whose gage was maintained for long drilling periods.

Up to that time, practically all advances were made by post-mortem investigation, vague allusion to the shortcomings of the steel maker and rod fabricator, and the drill runner himself did not escape completely unscathed. Few asked what drill steel was expected, actually, to do in terms related to the science of metals. During World War II such questions began being discussed. L. O. Cooper, in 1941, discussed "Stresses in Drill Steel." T. W. Wlodek simulated drill rod service by fatigue tests conducted in the laboratory to evaluate the worth of surface treatments such as induction hardening, shot peening, spiral rolling and corrosion preventive coatings. He related the performance of drill rods to their fatigue strength. The way was shown for laboratory tests to advance the performance of drill rods at a much faster pace than ever possible by the old trial and error methods. A few laboratory developments made by Gardner-Denver Co. will be briefly presented to show that progress can be accelerated only by planned research.

A written discussion to Wlodek's paper, "The Effect of Water Corrosion and Shot Peening on Fatigue Strength of Mining Drill Rods," *C. I. M. Transactions*, Vol. LV, 1952, presented results of work done to measure stresses developed in drill steel during actual drilling of rock. Results of this work, shown graphically in Figure 1 boil down to three important facts:

(1) **Stresses often exceed the endurance strength of properly treated, plain carbon steel.**
(2) **Use of dull bits greatly intensify stresses.**
(3) **Misalignment further intensifies stresses although to a lesser degree.**

In this work, while maximum stresses were high, there was offered the hope that by use of highly hardened and favorably stressed steel, service life could be greatly extended, perhaps to the point failure would be by wear rather than breakage.

### Laboratory Tests Find Causes of Early Failure

In the development of steel for long hole drilling, many endurance tests were made on plain carbon drill rod, high carbon alloy rod, low carbon alloy and carburized rod. It soon developed that carbon rod gave only one-fourth the service obtainable from high carbon alloy rod despite the fact both were treated to the same hardness for their full length—no "metallurgical notches" or low hardness transition areas being present in either. This was at variance with accepted hardness-strength relationships and it was left to a simple laboratory test to provide the explanation.

One of the clues was the fact that failure of the carbon rods had its origin in the tube hole surface; in the high carbon alloy, origin was in the outside surface, where any self-respecting origin should be. Trapped stresses were suspected and, to prove it, a six in. length of each type in a one-in. hex section was treated to 40 Rockwell "C" (the carbon steel by oil-quenching from 1600° F and the alloy steel by air cooling from 1600° F) and then ground flat and parallel to permit accurate length measurements. Each were then turned in a lathe to a diameter of ⅞ in. and the length again measured. The same was repeated at ¾, ⅝, ½ and ⅜-in. diam., the last producing a tube with a ⅜-in. outside diam. having the ¼-in. inside diam. tube hole. The length changes were plotted as shown in Figure 2 in terms of change per inch of length. By these tests it was found the alloy steel changed none at all while the carbon rod shortened 0.0016 in. per in. of length. This indicated a tensile stress in the surface of the tube hole in the carbon rod amounting to 50,000 psi compared to

### ABOUT THE AUTHOR

**Floyd R. Anderson's principal activity has been relating field performance to product quality in percussion drilling equipment. His career started as laboratory assistant at Denver Rock Drill Manufacturing Co. in 1925. He then served as metallographist at Colorado Fuel and Iron Co. at Pueblo, Colo., for four years. Anderson returned to Gardner-Denver Co. in 1934 as assistant metallurgist. In 1937 he became chief metallurgist and now holds the position of assistant manager.**

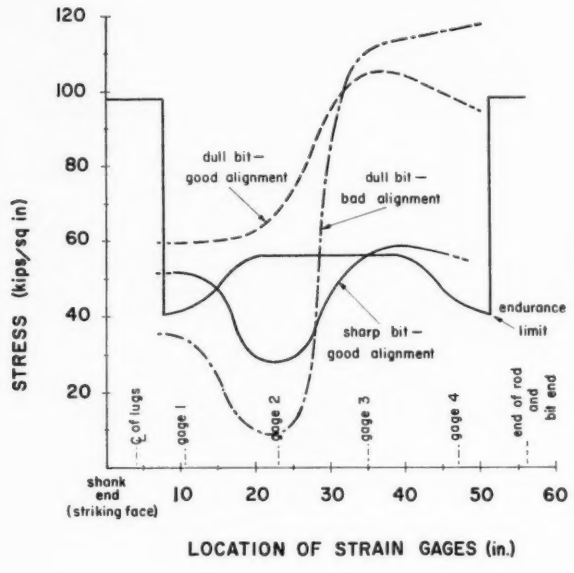



Figure 1. Maximum tensile stresses in drill rod during drilling operations

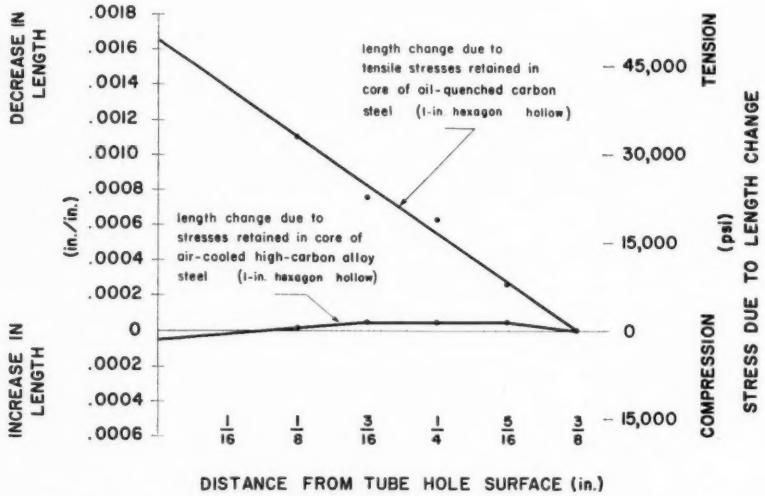
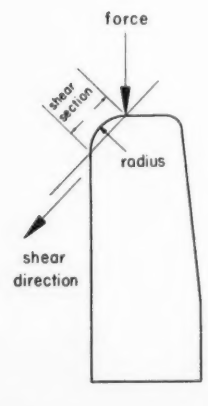



Figure 2. Tensile stresses as determined by length changes in carbon and alloy steels treated to 40 Rockwell "C"




LOADING UNDER CONDITIONS OF MISALIGNMENT

| | | | |
|---|---|---|---|
| radius (in.) | 1/32 | 1/16 | 1/8 |
| shear section (in.) | .044 | .088 | .177 |
| lines of force (photoelastic) | 17 | 15 | 13 |
| relative shear (psi) | 31,000 | 13,600 | 5,800 |

Figure 3. Analysis of stress on shank striking ends

zero stress in the alloy rod. In other words, the carbon rod began its service with a 50,000 psi pre-load in the tube hole which, added to operating stresses, caused failure to originate and progress to completion in one-fourth the operating time. The laboratory test pinpointed the cause; namely, the non-uniform cooling of the carbon rod cross-section because of oil quenching.

## Harder Steel Studied

Up to this point, steel at a maximum of 45 Rockwell "C" has been discussed. In fact, the use of steel at higher hardness had been strongly discouraged because of its bad effect on the striking face of hammers and tappets. Reams have been written on this point and some alloy steels have been metallurgically designed to absolutely prevent attainment of hardness equal to or in excess of, the 60 Rockwell "C" piston hardness. Apparently, no one had bothered to ask "Why," in spite of the fact pistons at 60 Rockwell "C" had been striking tappets at the same hardness for years with no ill effects.

It had been known for at least 25 years that rock drill parts expected to resist vibratory stresses required case-core structure of high case hardness. It also had been learned that case strength values of such parts were in excess of the stresses measured in drill steel as tested and shown in the chart of Figure 1. Fortified with this bit of data it seemed that drill steel should embody these same high properties and it remained only to apply this deduction to practice. At this point, the practical problem of effect of high shank hardness on piston faces had to be met, a fact which had been carefully avoided in conventional steels.

Going back to the mutually hard tappet-hammer combination, it seemed that good alignment between the two parts, assuring ample area of contact, was probably the answer to satisfactory service. Drill shanks, on the other hand, seemed to offer little assurance of such nice alignment because of the length of rods involved and frequent use of worn chucks. Despite the dark outlook and weight of past experience, laboratory tests again pointed the way and provided the solution. Photoelastic stress studies of a hammer face, made of plastic, loaded against a shank striking end, also of plastic, showed that a ⅛-in. radius reduced stresses responsible for chipping by more than 80 percent! This is illustrated in Figure 3. Proof of the validity of this test is in the several years of experience with hard shanks used against pistons of equal hardness with no instance of premature hammer damage.

More recent laboratory research was aimed at measurement of energy

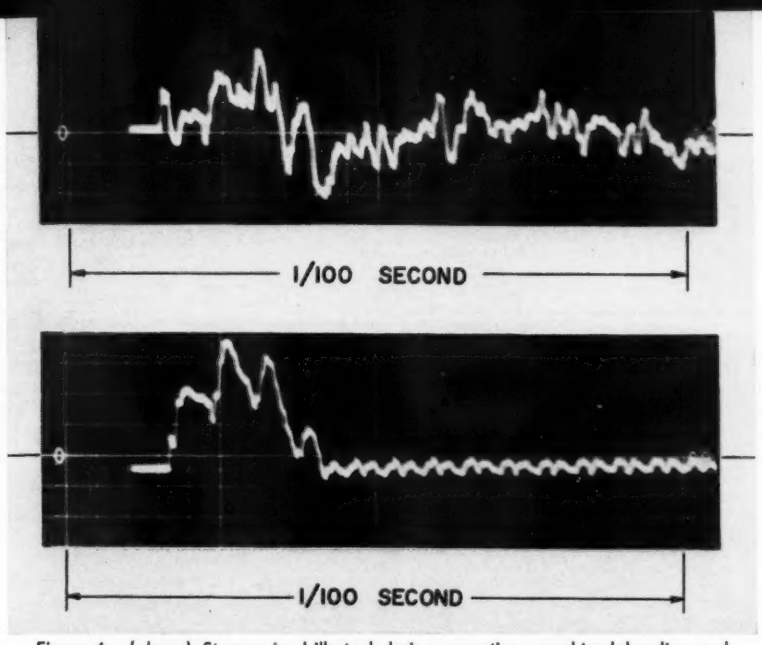



Figure 4. (above) Stresses in drill steel during operation—combined bending and end impulse vibrations over a 1/100 second interval. (below) Stresses in drill steel during operation—end impulse vibrations only over a 1/100 second interval

transmission by drill rods and long hole steel assemblies of various sizes, and types of material. These measurements were made by use of bonded wire strain gages on a calibrated load cell connected to a cathode ray oscillograph from which photographic records are obtained. Results of the laboratory stress studies were validated by carefully conducted rock drilling tests using identical equipment. Agreement between the two methods was almost perfect.

Table 1 gives, in brief, the important findings of this study. It is shown that drill steel is only 10 to 27 percent efficient in transmitting drilling energy from the rock drill piston hammer to the bit. It also shows that carburized steel is a more efficient medium than conventional drill steel by 6½ to 46 percent. Energy losses in joints of sectional steel assemblies are also evident.

TABLE 1.—ENERGY TRANSMISSION BY DRILL RODS AND LONG HOLE STEEL ASSEMBLIES OF VARIOUS SIZES AND TYPES OF MATERIAL

| TYPE OF DRILL ROD | Energy Product (ft-lb/min) | Drilling Speed (in./min) | Efficiency Block Test (%) | Efficiency Drilling Test (%) |
|---|---|---|---|---|
| Compression Block Directly Struck by Hammer | 480K | 67.3 | 100.0 | 100.0 |
| One-piece Rod 1¼ in. Round, 42 in. Long, Carburized | 112K | 15.8 | 23.4 | 23.4 |
| Sectional Rod, Carburized Shank, Coupling 1¼ in. Hex., 48 in. Long, Carburized Rod | 104K | 13.5 | 21.7 | 20.1 |
| One-piece Rod, 1 in. Hex., 42 in. Long, Carburized | 110K | 13.0 | 23.0 | 19.3 |
| One-piece Rod 1¼ in. Round, 42 in. Long, Plain Carbon, Hardened | 104K | 12.9 | 21.7 | 19.2 |
| Sectional Rod, Carburized Shank, Coupling 1¼ in. Hex., 96 in. Long, Carburized Rod | 86K | 11.6 | 17.9 | 17.2 |
| Sectional Rod, Carburized Shank, Coupling, 1 in. Hex., 48 in. Long, Alloy Rod | 86K | 11.5 | 17.9 | 17.1 |
| Sectional Rod, Alloy Shank, Coupling 1 in. Hex., 48 in. Long, Alloy Rod | 83K | 10.9 | 17.3 | 16.3 |
| One-piece Rod, 1 in. Hex., 42 in. Long, Plain Carbon, Hardened | 76K | 10.0 | 15.7 | 14.9 |
| Sectional Rod, Carburized Shank, Coupling 1 in. Hex., 96 in. Long, Alloy Rod | 76K | 9.5 | 15.7 | 14.1 |
| Sectional Rod, Alloy Shank, Coupling 1 in. Hex., 96 in. Long, Alloy Rod | 75K | 8.6 | 15.6 | 12.8 |
| Sectional Rod, Carburized Shank, Coupling, Two 1 in. Hex., 48 in. Long, Alloy Rods | 75K | 9.8 | 15.6 | 14.5 |
| Sectional Rod, Alloy Shank, Coupling, Two 1 in. Hex., 48 in. Long, Alloy Rods | 67K | 9.4 | 14.0 | 13.9 |
| One-piece Rod, ⅞ in. Hex., 42 in. Long, Carburized | 71K | 9.0 | 14.9 | 13.4 |
| One-piece Rod, ⅞ in. Hex., 42 in. Long, Plain Carbon, Hardened | 67K | 7.5 | 14.0 | 11.2 |

## Research Conducted on Effect of Impact

A more basic study is the recording of stresses imparted to a drill rod by a single hammer impact. This is done by means of bonded wire strain gages attached to the drill steel subjected to impact and vibrations recorded by an oscillograph. In Figure 4 (above) are shown the stresses, tensile and compressive, imparted to a steel during a 1/100 second interval. The complex pattern results from the fact that stresses resulting both from bending and impulse are recorded. By modifying the gage locations, to cancel bending stresses, only the end impulse stresses are shown in Figure 4 (below). Since a four-ft long rod was used, the shock wave had to travel eight ft to make a round trip from shank end to bit back to shank. Since sound or shock travels through steel at about 16,000 fps, it follows that 2000 round trips per second are accomplished. In Figure 4 (below), these successive impulses are nicely shown persisting from a single blow for four cycles having a total duration of 1/400 second only. Since rate of rock drill hammer blows are about 30 per seconds, it follows that the end impulses pretty well die out between blows. Bending vibrations, however, as shown in Figure 4, persist throughout the drilling operation.

These recordings, as such, are of academic interest only. Related to actual drilling, however, they are tools which enable analysis of the many variable factors entering into drilling operations.

They help evaluate drill, drill steel and bit design. They point up to evils of using dull bits, steel too small in section, drills too large in impact energy, misalignment and improper feeding. In taking time to assimilate this paper, the reader, no doubt, is left with the strong impression that a metallurgist is going to great lengths to point out the importance of mechanical rather than metallurgical factors influencing drill steel performance. Hardness tests, chemical analysis and micro-examination are important as controls of material quality, but a device doing mechanical work should be so analyzed. Intelligent analysis must be based on accurate measurements obtainable at their best in the laboratory by laboratory means. Properly translated, such tests grow into products capable of rendering more efficient drilling performance.

# CONTINUOUS MINING PRODUCTIVITY

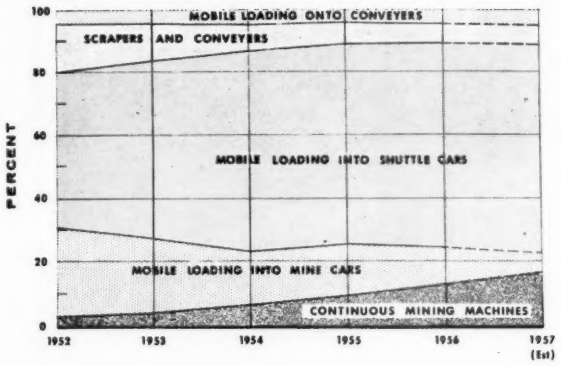



Fig. 1. Percentage of total mechanically loaded output at underground bituminous coal and lignite mines in the United States by method of mining and loading, 1952-57

## Production statistics show why continuous mining grows in favor with coal producers

By R. L. ANDERSON

Supervisory Commodity-Industry Analyst-Coal
U. S. Bureau of Mines

ALTHOUGH continuous mining machines, known as "Entry Drivers," were in use in underground bituminous coal mines in the early twenties, continuous mining as known today actually began in the United States in 1948. Production from this type of mining was first measured separately in 1952, when it totaled 8,000,000 tons of bituminous coal. It is estimated that 50,000,000 tons was produced last year, 1957, by continuous mining. There were 510 continuous mining machines in use in bituminous coal mines in 1956, and in 1957, six manufacturers shipped 168 more.

### Production by Continuous Mining Increasing

Figure 1 shows that in recent years production by continuous mining has been increasing steadily while conventional mining by "scrapers and conveyors" and by "mobile loading into mine cars" has been decreasing. However, "mobile loading into shuttle cars" also has been increasing. Hand loading has been omitted here because the percentage of underground output loaded by hand has changed little in the past three years.

The coal industry now has had ten years' experience in continuous mining. The latest year for which data are available on productivity by method of mining is 1956. Continuous mining was practiced in 14 states and Alaska. Twenty-four mines operated with "Continuous mining only" in 1956; their productivity averaged 14.08 tons per man per day, about three tons higher than that of any other group included in this study. (See figure 2.)

The group of mines with the second highest productivity rate was "Conventional mining—mobile loading into shuttle cars," which averaged 11.17 tons per man per day. It is most interesting to note that average productivity in Illinois for "Mobile loading into shuttle cars" was higher than the average of the total for all mines in the group "Continuous mining only."

### Mechanical Loading Accounts for 86 Percent of Underground Output

Annual reports submitted by bituminous coal and lignite producers list net tons of coal loaded by various methods and the number of continuous mining machines and loading machines by type of loading. These data are assembled by type of equipment to show mechanical loading, by states, and are published regularly by the Bureau of Mines in the familiar mechanical loading tables of the *Mineral Market Summary* for bituminous coal and lignite and of the *Minerals Yearbook*.

However, productivity data for all underground bituminous coal and lignite mines by method of mining and loading, as presented here, have never been compiled before. Data on production by method of mining and loading were assembled from production and mine operation reports, Form 6-1401-A, submitted by producers to the Branch of Bituminous Coal Economics and Statistics, Division of Bituminous Coal. They were related to corresponding data on employment reported to the Accident Analysis Branch, Federal Bureau of Mines, on Form 6-1420-A. As employment data reported by the operators are for total employment, not employment by method of loading, total production figures have been used to calculate the productivity rates shown in this report.

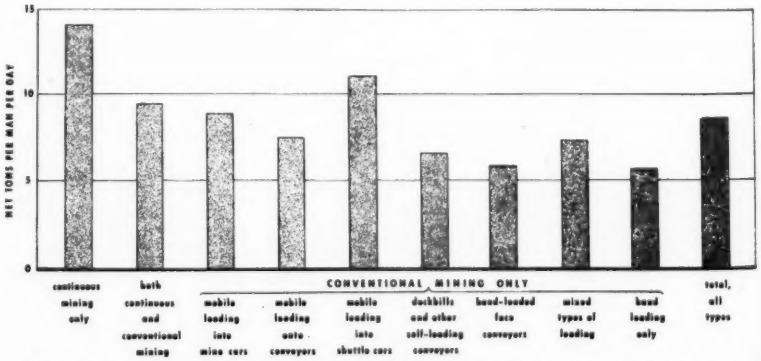



Fig. 2. Output per man per day at underground bituminous coal and lignite mines in the United States by method of mining and loading, in 1956

Total production of underground bituminous coal and lignite mines was 366,000,000 tons in 1956. Mines with mechanical loading produced 316,000,000 tons and mines with hand loading produced 50,000,000 tons. Table 34, page 62, of Bureau of Mines *Mineral Market Summary* No. 2715 lists total production, by states, at mines using mechanical loading devices. These totals are comparable to the production figures used in this article.

Productivity calculations were based on total manshifts worked and the average number of men working daily, both underground and surface, including those working at the tipple, preparation plant, and mine shops and yards, but excluding office workers. Thickness of coal mined was reported by the producers. Thickness of coal seam was not compiled for mines using hand loading only, as many of the small mines did not report thickness. The average thickness of coal mined was based on production.

All tonnage figures represent net tons of marketable coal and exclude washery and other refuse. "Tons" refers to net short tons of 2000 lbs.

This report includes all underground mines producing 1000 tons a year or more, but does not attempt to cover many small mines producing less than 1000 tons a year.

## Productivity Varies Widely

Even though 43 percent of the total underground production of bituminous coal and lignite in the United States was produced at mines with mixed methods of mining and mixed types of loading, it is believed that the productivity, as shown in the tables for all the other groups, is representative.

In the tables the mines have been separated into nine groups. (See table I.) The first seven groups include mines with 90 percent or more of total production loaded mechanically. The eighth group, "Mixed types of loading," includes conventional mining with mixed types of loading, also other methods of mining and mechanical loading with less than 90 percent of total output mechanically loaded. As scraper loading was too small to be listed separately, it was included with "Mixed types of loading." Figure 2 shows productivity by method of mining and loading for all underground bituminous coal and lignite mines in the United States in 1956.

Average productivity by states for the first group of mines, "Continuous mining only," varied from 11.20 tons per man per day in Pennsylvania to 18.95 in West Virginia. This great difference was owing to many conditions besides the thickness of coal mined, because the state with the highest productivity had the lowest average thickness of coal mined.

Three states—Ohio, Pennsylvania, and West Virginia—had enough

TABLE 1—Productivity at underground bituminous coal and lignite mines in the United States, and in three individual states, by method of mining and loading in 1956

| Method | ALL STATES | | | | | OHIO | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average tons per man per day[1] | Number of mines | Production | | Average thickness of coal mined (in.) | Average tons per man per day[1] | Number of mines | Production | | Average thickness of coal mined (in.) |
| | | | Thousand net tons | Percentage of total | | | | Thousand net tons | Percentage of total | |
| Continuous mining only | 14.08 | 24 | 8,667 | 2.4 | 80 | 14.67 | 3 | 1,599 | 11.9 | 58 |
| Both continuous and conventional mining | 9.46 | 132 | 105,385 | 28.8 | 64 | 10.65 | 3 | 3,410 | 25.4 | 55 |
| Conventional mining only: | | | | | | | | | | |
| Mobile loading into mine cars | 8.82 | 131 | 14,853 | 4.1 | 61 | 11.52 | 7 | 2,716 | 20.2 | 54 |
| Mobile loading onto conveyors | 7.47 | 48 | 6,205 | 1.7 | 39 | 10.15 | 4 | 167 | 1.2 | 48 |
| Mobile loading into shuttle cars | 11.17 | 380 | 120,150 | 32.8 | 61 | 9.88 | 11 | 3,888 | 29.0 | 55 |
| Duckbills and other self-loading conveyors | 6.50 | 45 | 2,371 | .6 | 42 | (1) | 1 | (1) | .7 | (1) |
| Hand-loaded face conveyors | 5.89 | 228 | 7,404 | 2.0 | 39 | 4.68 | 14 | 91 | 2.5 | 46 |
| Mixed types of loading[2] | 7.35 | 254 | 50,664 | 13.9 | 52 | 8.27 | 11 | 336 | 9.1 | (3) |
| Hand loading only | 5.65 | 5,300 | 50,075 | 13.7 | (3) | 4.46 | 132 | 1,216[4] | | |
| Total | 8.62 | 6,542 | 365,774 | 100.0 | (3) | 9.53 | 206 | 13,423 | 100.0 | (3) |

| Method | PENNSYLVANIA | | | | | WEST VIRGINIA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average tons per man per day[1] | Number of mines | Production | | Average thickness of coal mined (in.) | Average tons per man per day[1] | Number of mines | Production | | Average thickness of coal mined (in.) |
| | | | Thousand net tons | Percentage of total | | | | Thousand net tons | Percentage of total | |
| Continuous mining only | 11.20 | 8 | 2,835 | 4.3 | 80 | 18.95 | 6 | 1,258 | .9 | 52 |
| Both continuous and conventional mining | 8.02 | 53 | 38,556 | 58.0 | 59 | 10.70 | 41 | 38,983 | 28.0 | 62 |
| Conventional mining only: | | | | | | | | | | |
| Mobile loading into mine cars | 6.37 | 16 | 2,136 | 3.2 | 58 | 8.95 | 40 | 4,757 | 3.4 | 64 |
| Mobile loading onto conveyors | 8.55 | 7 | 311 | .5 | 42 | 7.67 | 22 | 3,782 | 2.7 | 37 |
| Mobile loading into shuttle cars | 9.61 | 34 | 8,806 | 13.2 | 55 | 10.97 | 137 | 46,090 | 33.1 | 58 |
| Duckbills and other self-loading conveyors | 5.60 | 17 | 667 | 1.0 | 42 | 6.49 | 5 | 893 | .6 | 31 |
| Hand-loaded face conveyors | 5.49 | 89 | 2,334 | 3.5 | 39 | 7.38 | 60 | 3,341 | 2.4 | 40 |
| Mixed types of loading[2] | 7.05[5] | 42[5] | 5,351[5] | 8.0[5] | 47[5] | 7.70[6] | 87[6] | 28,931[6] | 20.8[6] | 50[6] |
| Hand loading only | 4.11 | 731 | 5,492 | 8.3 | (3) | 5.24 | 890 | 11,237 | 8.1 | (3) |
| Total | 7.40 | 997 | 66,488 | 100.0 | (3) | 9.03 | 1,278 | 139,272 | 100.0 | (3) |

[1] *Calculated on basis of average number of men working daily. This includes all men engaged in the production and preparation of coal.*
[2] *Includes four mines with a small tonnage mined by continuous mining.*
[3] *Not available.*
[4] *Included in "mixed types of loading"; not published to avoid disclosing individual operations.*
[5] *Includes one mine with a small tonnage mined by continuous mining.*
[6] *Includes three mines with a small tonnage mined by continuous mining.*

**TABLE 2—Productivity at underground bituminous coal and lignite mines in the United States, by method of mining and loading, by States, 1956**

| State | Average tons per man per day[1] | Number of mines | Production: Thousand net tons | Production: Percentage of total | Average thickness of coal mined (in.) |
|---|---|---|---|---|---|
| **CONTINUOUS MINING ONLY** | | | | | |
| Ohio | 14.67 | 3 | 1,590 | 18.5 | 58 |
| Pennsylvania | 11.20 | 8 | 2,835 | 32.7 | 80 |
| West Virginia | 18.95 | 6 | 1,258 | 14.5 | 52 |
| Other States | 15.90 | 7 | 2,975 | 34.3 | 103 |
| Total | 14.08 | 24 | 8,667 | 100.0 | 80 |
| **BOTH CONTINUOUS AND CONVENTIONAL MINING** | | | | | |
| Colorado | 9.34 | 3 | 204 | .2 | 100 |
| Illinois | 16.39 | 5 | 6,822 | 6.5 | 95 |
| Kentucky | 9.16 | 7 | 6,493 | 6.1 | 52 |
| Ohio | 10.65 | 3 | 3,410 | 3.2 | 55 |
| Pennsylvania | 8.02 | 53 | 38,556 | 36.6 | 59 |
| Utah | 9.77 | 5 | 2,603 | 2.5 | 127 |
| Virginia | 7.93 | 5 | 4,138 | 3.9 | 66 |
| West Virginia | 10.70 | 41 | 38,983 | 37.0 | 62 |
| Other States | 9.57 | 10 | 4,176 | 4.0 | 61 |
| Total | 9.46 | 132 | 105,385 | 100.0 | 64 |
| **CONVENTIONAL MINING—MOBILE LOADING INTO MINE CARS** | | | | | |
| Illinois | 10.81 | 13 | 2,150 | 14.5 | 77 |
| Indiana | 9.88 | 7 | 109 | .7 | 73 |
| Kentucky | 8.09 | 32 | 2,129 | 14.3 | 48 |
| Montana (bit.) | 9.20 | 3 | 239 | 1.6 | 78 |
| Ohio | 11.52 | 7 | 2,716 | 18.3 | 54 |
| Pennsylvania | 6.37 | 16 | 2,136 | 14.4 | 58 |
| Virginia | 6.75 | 5 | 387 | 2.6 | 53 |
| West Virginia | 8.95 | 40 | 4,757 | 32.0 | 64 |
| Other States | 8.90 | 8 | 230 | 1.6 | 105 |
| Total | 8.82 | 131 | 14,853 | 100.0 | 61 |
| **CONVENTIONAL MINING—MOBILE LOADING ONTO CONVEYORS** | | | | | |
| Kentucky | 8.96 | 5 | 1,030 | 16.6 | 43 |
| Ohio | 10.15 | 4 | 167 | 2.7 | 48 |
| Pennsylvania | 8.55 | 7 | 311 | 5.0 | 42 |
| Tennessee | 6.84 | 4 | 263 | 4.2 | 38 |
| West Virginia | 7.67 | 22 | 3,782 | 61.0 | 37 |
| Other States | 4.98 | 6 | 652 | 10.5 | 43 |
| Total | 7.47 | 48 | 6,205 | 100.0 | 39 |
| **CONVENTIONAL MINING—MOBILE LOADING INTO SHUTTLE CARS** | | | | | |
| Alabama | 6.61 | 9 | 4,126 | 3.4 | 56 |
| Colorado | 9.96 | 11 | 770 | .6 | 127 |
| Illinois | 16.88 | 31 | 15,616 | 13.0 | 69 |
| Indiana | 11.73 | 16 | 4,104 | 3.4 | 65 |
| Kentucky | 11.66 | 73 | 23,962 | 20.0 | 54 |
| Mont. (bit. & lig.) | 6.59 | 3 | 95 | .1 | 72 |
| Ohio | 9.88 | 11 | 3,888 | 3.2 | 55 |
| Pennsylvania | 9.61 | 34 | 8,806 | 7.3 | 55 |
| Tennessee | 12.67 | 7 | 1,827 | 1.5 | 59 |
| Utah | 10.48 | 28 | 3,642 | 3.0 | 134 |
| Virginia | 10.23 | 26 | 7,051 | 5.9 | 56 |
| West Virginia | 10.97 | 127 | 46,090 | 38.4 | 58 |
| Other States | 10.22 | 4 | 173 | .2 | 57 |
| Total | 11.17 | 380 | 120,150 | 100.0 | 61 |
| **CONVENTIONAL MINING—DUCKBILLS OR OTHER SELF-LOADING CONVEYORS** | | | | | |
| Colorado | 7.10 | 11 | 270 | 11.4 | 76 |
| Montana (bit.) | 7.52 | 3 | 21 | .9 | 61 |
| Pennsylvania | 5.60 | 17 | 667 | 28.1 | 42 |
| West Virginia | 6.49 | 5 | 893 | 37.7 | 31 |
| Other States | 7.70 | 9 | 520 | 21.9 | 42 |
| Total | 6.50 | 45 | 2,371 | 100.0 | 42 |
| **CONVENTIONAL MINING—HAND-LOADED FACE CONVEYORS** | | | | | |
| Alabama | 5.21 | 7 | 51 | .6 | 27 |
| Arkansas | 4.13 | 7 | 254 | 3.4 | 31 |
| Colorado | 6.08 | 15 | 85 | 1.2 | 68 |
| Kentucky | 4.81 | 15 | 342 | 4.6 | 37 |
| Maryland | 5.61 | 5 | 122 | 1.7 | 32 |
| Ohio | 4.68 | 14 | 91 | 1.2 | 40 |
| Oklahoma | 4.05 | 4 | 400 | 5.4 | 36 |
| Pennsylvania | 5.49 | 89 | 2,334 | 31.5 | 39 |
| Tennessee | 4.36 | 5 | 176 | 2.4 | 34 |
| Virginia | 4.88 | 5 | 197 | 2.7 | 34 |
| West Virginia | 7.38 | 60 | 3,341 | 45.1 | 40 |
| Other States | 7.40 | 2 | 11 | .2 | 52 |
| Total | 5.89 | 228 | 7,404 | 100.0 | 39 |
| **CONVENTIONAL MINING—MIXED TYPES OF LOADING[2]** | | | | | |
| Alabama | 5.48 | 9 | 2,414 | 4.8 | 53 |
| Colorado | 4.62 | 18 | 1,527 | 3.0 | 75 |
| Illinois | 10.81 | 4 | 776 | 1.5 | 90 |
| Kentucky | 7.50 | 39 | 7,357 | 14.5 | 45 |
| Ohio | 8.27 | 11 | 336 | .7 | 46 |
| Pennsylvania | 7.05 | 42 | 5,351 | 10.6 | 47 |
| Utah | 7.94 | 3 | 87 | .2 | 78 |
| Virginia | 7.50 | 26 | 2,800 | 5.5 | 49 |
| Washington | 6.13 | 3 | 100 | .2 | 96 |
| West Virginia | 7.70 | 87 | 28,931 | 57.1 | 50 |
| Wyoming | 9.05 | 4 | 568 | 1.1 | 107 |
| Other States | 8.38 | 8 | 417 | .8 | 180 |
| Total | 7.35 | 254 | 50,664 | 100.0 | 52 |
| **TOTAL—ALL MINES WITH MECHANICAL LOADING** | | | | | |
| All States and Alaska | 9.41 | 1,242 | 315,699 | 86.3 | 60 |
| **TOTAL—ALL MINES WITH HAND LOADING ONLY** | | | | | |
| All States and Alaska | 5.65 | 5,300 | 50,075 | 13.7 | (3) |
| **GRAND TOTAL—ALL UNDERGROUND MINES** | | | | | |
| All States and Alaska | 8.62 | 6,542 | 365,774 | 100.0 | (3) |

[1] *Calculated on basis of average number of men working daily. This includes all men engaged in the production and preparation of coal.*
[2] *Includes four mines with a small tonnage mined by continuous mining.*
[3] *Not available.*

mines in the first group, "Continuous mining only," in 1956 to be listed separately. Figure 3 and table I show comparative productivity data for these three states.

The second group, "Both continuous and conventional mining," includes mines in which both continuous mining machines and other loading devices, not used in conjunction with the continuous mining machines, were operated. In 1956 this group produced 31,000,000 tons by continuous mining and 74,000,000 tons by conventional mining. The conventional mining part of this tonnage was divided as follows: Mobile loading into mine cars, 10,000,000 tons; mobile loading onto conveyors, 2,000,000 tons; mobile loading into shuttle cars, 60,000,000 tons; and Duckbills or other self-loading conveyors, scraper loaders, and hand-loaded face conveyors, 2,000,000 tons.

## 24 Mines Employ Continuous Mining Only

Table II lists detailed data on productivity by states for the various methods of mining and mechanical loading.

The first group of table II, "Continuous mining only," included 24 mines in eight states. These mines employed 98 continuous mining ma-

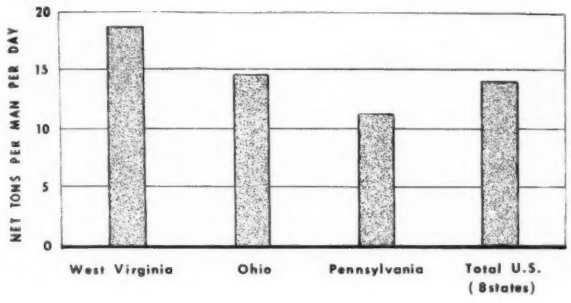



Fig. 3. Output per man per day at bituminous coal mines in the United States, using continuous mining only, in 1956

**R. L. Anderson joined the government in 1934 following several years' employment with a firm of consulting mining engineers in Pittsburgh, Pa. He has had broad experience in various Federal agencies having to do with coal and is widely known as an authority on coal statistics. His report on continuous mining productivity supplies a wealth of much needed information in an area that is becoming increasingly vital to the mining industry.**

chines and 49 loading machines used in conjunction with continuous mining. They produced 9,000,000 tons, or 22 percent, of the total 40,000,000 tons mined by continuous mining in 1956.

The second group, "Both continuous and conventional mining," included 132 mines in 15 states. These mines employed 407 continuous mining machines and 139 mobile loading machines used in conjunction with continuous mining. In addition, the following numbers of loading devices were used: Mobile loading machines into mine cars, 180; mobile loading machines onto conveyors, 43; mobile loading machines into shuttle cars, 747; Duckbills or other self-loading conveyors, 64; hand-loaded face conveyors, 256; and scraper loaders, 14.

Average productivity by states for this group varied from a low of 7.93 tons per man per day at Virginia mines to a high of 16.39 at Illinois mines. Thirty-one percent of the total underground output of bituminous coal and lignite in 1956 was produced by mines using continuous mining machines in part or all of the mine.

The third group, "Conventional mining—mobile loading into mine cars," included mines in 14 states employing 357 loading units. Pennsylvania registered the lowest tons per man per day—6.37—and Ohio the highest—11.52—for this group. The average for all states was slightly higher than the average for all methods of mining and loading at underground mines.

The fourth group, "Mobile loading onto conveyors," employed 170 loading units and ranged from 4.98 tons per man per day in "Other States" to 10.15 in Ohio. Average productivity for this group was about two tons per man per day higher than for the group "Hand-loaded face conveyors" and one ton per man per day higher than for the group "Duckbills or other self-loading conveyors." The average thickness of coal mined was 39 in. for both groups, "Mobile loading onto conveyors" and "Hand-loaded face conveyors."

## Illinois—16.88 Tons Per Man Per Day

The fifth group, "Mobile loading into shuttle cars," produced one-third of the underground output in 1956 and averaged a higher productivity than any other except "Continuous mining only." This group included 380 mines in 14 states employing 1472 mobile loading machines. Average tons per man per day ranged from 6.59 in Montana to 16.88 in Illinois.

The sixth group, "Duckbills or other self-loading conveyors," included mines in ten states employing 223 loading devices. Productivity in this group varied from 5.60 tons per man per day at Pennsylvania mines to 7.70 at mines in "Other States."

The seventh group, "Hand-loaded face conveyors," included mines with the lowest productivity of any group employing mechanical loading. It included 228 mines in 13 states employing 898 conveyor units.

The eighth group, "Mixed types of loading," included 254 mines in 16

*(Continued on page 60)*

**TABLE 3—Productivity at underground bituminous coal and lignite mines in the United States, with mechanical loading compared with mines with hand loading only, by states, 1956**

| State | Average tons per man per day[1] | | | Number of mines | | | Production (thousand net tons) | | | Percentage of total Production | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mechanical | Hand | Total | Mechanical | Hand | Total | Mechanical | Hand | Total | Mechanical | Hand | Total |
| Alabama | 6.88 | 4.47 | 6.52 | 29 | 160 | 189 | 9,321 | 1,077 | 10,398 | 89.6 | 10.4 | 100.0 |
| Arkansas | 3.95 | 3.00 | 3.90 | 8 | 7 | 15 | 324 | 11 | 335 | 96.7 | 3.3 | 100.0 |
| Colorado | 5.98 | 4.15 | 5.81 | 62 | 44 | 106 | 2,946 | 198 | 3,144 | 93.7 | 6.3 | 100.0 |
| Illinois | 15.84 | 5.07 | 15.26 | 58 | 36 | 94 | 28,105 | 322 | 28,427 | 98.9 | 1.1 | 100.0 |
| Indiana | 11.97 | 5.63 | 11.67 | 24 | 19 | 43 | 5,056 | 119 | 5,175 | 97.7 | 2.3 | 100.0 |
| Iowa | 10.46 | 3.45 | 4.11 | 3 | 30 | 33 | 66 | 208 | 274 | 24.1 | 75.9 | 100.0 |
| Kentucky | 9.86 | 6.59 | 8.69 | 173 | 1,689 | 1,862 | 41,563 | 15,425 | 56,988 | 72.9 | 27.1 | 100.0 |
| Maryland | 5.55 | 3.61 | 4.15 | 6 | 62 | 68 | 125 | 213 | 338 | 37.0 | 63.0 | 100.0 |
| Montana (bituminous and lignite) | 8.22 | 4.15 | 7.51 | 10 | 9 | 19 | 358 | 38 | 396 | 90.4 | 9.6 | 100.0 |
| New Mexico | 6.95 | 2.88 | 3.85 | 2 | 22 | 24 | 63 | 83 | 146 | 43.2 | 56.8 | 100.0 |
| Ohio | 10.75 | 4.46 | 9.53 | 54 | 152 | 206 | 12,208 | 1,216 | 13,424 | 90.9 | 9.1 | 100.0 |
| Oklahoma | 4.20 | 2.20 | 4.00 | 5 | 9 | 14 | 465 | 27 | 492 | 94.5 | 5.5 | 100.0 |
| Pennsylvania | 7.97 | 4.11 | 7.40 | 266 | 731 | 997 | 60,997 | 5,492 | 66,489 | 91.7 | 8.3 | 100.0 |
| Tennessee | 9.67 | 5.13 | 6.47 | 21 | 430 | 451 | 2,890 | 3,666 | 6,556 | 44.1 | 55.9 | 100.0 |
| Utah | 10.17 | 6.12 | 10.15 | 41 | 8 | 49 | 6,511 | 11 | 6,522 | 99.8 | .2 | 100.0 |
| Virginia | 8.59 | 7.43 | 8.07 | 70 | 962 | 1,032 | 14,967 | 10,521 | 25,488 | 58.7 | 41.3 | 100.0 |
| Washington | 4.94 | 4.40 | 4.90 | 5 | 7 | 12 | 413 | 29 | 442 | 93.4 | 6.6 | 100.0 |
| West Virginia | 9.64 | 5.24 | 9.03 | 388 | 890 | 1,278 | 128,036 | 11,237 | 139,273 | 91.9 | 8.1 | 100.0 |
| Wyoming | 8.43 | 6.58 | 8.42 | 12 | 3 | 15 | 1,020 | 6 | 1,026 | 99.4 | .6 | 100.0 |
| Other States[2] | 5.40 | 2.95 | 4.06 | 5 | 30 | 35 | 265 | 176 | 441 | 60.1 | 39.9 | 100.0 |
| Total | 9.41 | 5.65 | 8.62 | 1,242 | 5,300 | 6,542 | 315,699 | 50,075 | 365,774 | 86.3 | 13.7 | 100.0 |

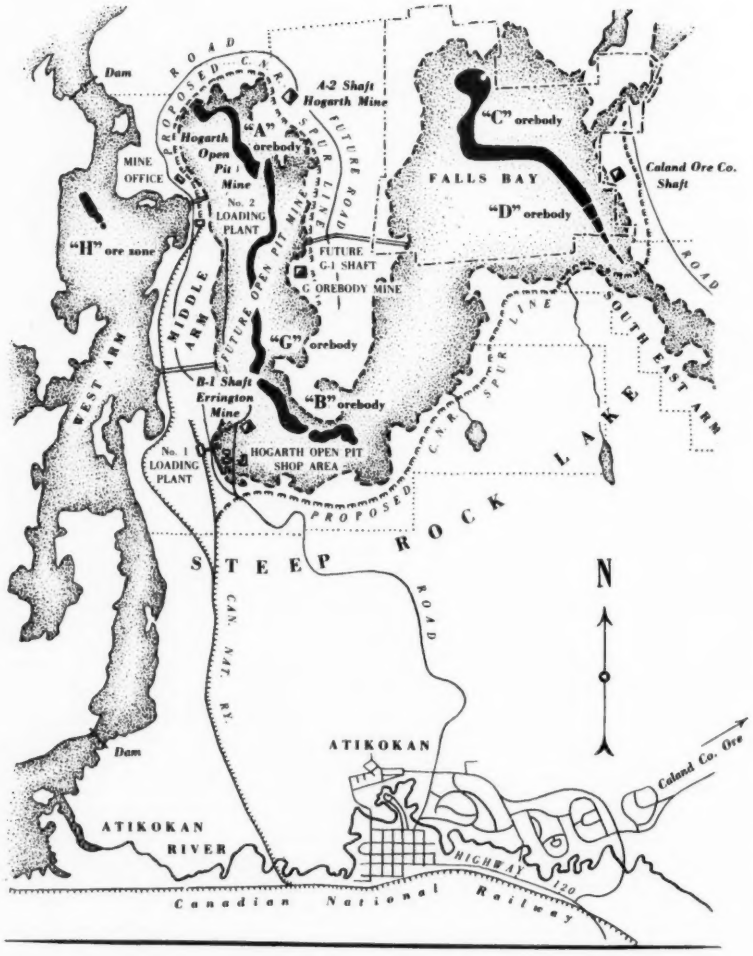
[1] *Calculated on basis of average number of men working daily. This includes all men engaged in the production and preparation of coal.*
[2] *Includes Alaska, Arizona, Georgia, Kansas, Missouri, and North Dakota (lignite).*

# STEEP ROCK'S HOGARTH SHAFT

**One of the largest single opening mines in North America is being developed at Steep Rock Lake, Ontario, with production plans set at 1000 long tons per hour**

By GERALD B. HAMILTON

Hogarth Mine Engineer
Steep Rock Iron Mines, Ltd.




STEEP ROCK LAKE AREA

Original Shore Line — — — — — Caland Co. Ore Lease —·—·— Scale

Boundary of Property ..... Proven Orebody FEET 1800 2400 3600

STEEP Rock Iron Mines Limited is located approximately 70 miles due north of Ely, Minnesota. The mine is serviced by a branch line of the Canadian National Railway which passes through the town of Atikokan, Ont., six miles south of the mine. High-grade iron ore is transported over a spur line from the mine to the town, and thence, 140 miles east to Fort William and Port Arthur at the head of the lakes. There it is transferred from the railroad cars, through the loading docks, into lake freighters destined for lower lake ports.

The occurrence of float ore on the shores of Steep Rock Lake were known at the turn of the century, but little work was done until the 1930's when the present company was formed.

Diamond drills, working from the ice during the winter months, probed into the lake bottom and indicated the now known ore occurrences. The incompetent greenstone and ash rock which constitute the hanging wall were inferior to the more competent carbonate and granite formations of the footwall. However, due to the extremely rough topography, the footwall areas were economically inaccessible in the early stages. As a result, the original spur from Atikokan to the "B"-zone arrived on the hanging wall side and most of the access to the ore bodies was established from this side.

The "B"-zone, or Errington Mine,

was the initial development, due to its relatively high elevation compared with the other known ore bodies, and also because this ore body was located closest to the access from Atikokan. Once rail facilities had been established and a loading plant built, somewhat over 9,000,000 tons were mined by open pit methods with a hanging wall access. Long range planning indicated a conversion from open-pit to underground mining methods, once the economic pit depths had been reached. As a result, prior to the completion of the "B" zone open pit, an underground shaft was put down to begin development of an underground operation and the "A" zone or Hogarth open pit was established two miles to the north. Again, due to the economics of the development, all access was provided from the hanging wall side. At present, all the production from Steep Rock is from the Hogarth open pit and the Errington underground.

## Switch to Underground Scheduled for 1960

Long range plans call for an ultimate sustained production of 5,500,000 tons annually. By 1960, the Hogarth open pit, currently producing in excess of 2,500,000 tons per year will have reached its economic limits and the operation will have to be converted to underground mining. The open pit will move along to the "G" zone, which lies below the "A" and "B" zones. Due to its narrower width, the scheduled production from the "G" zone will be 1,500,000 tons annually.

In order to meet the long term expansion plans, it was necessary to establish an underground unit capable of producing 2,500,000 tons and it became evident that this would have to be supplied by the Hogarth underground.

The decision to proceed with the preliminary design of the Hogarth underground, immediately presented the general engineering department with two problems—daily capacity and location. The shipping season consists of about 150 working days from mid-April to mid-November and it is desirable to maintain winter stockpiles at a minimum. Following intensive investigation, it was decided that the plant would be designed for 20,000 tpd hoisting capacity, or 1000 long tons per hour. This would enable the comfortable production of 2,500,000 tons per year, without accumulating a stockpile of more than 800,000 tons.

A plant of this capacity made the problem of location increasingly important, and while all the development to date had been from the hanging wall side, it was decided that in spite of these facilities, the new mine would be shifted over to the footwall. There, the more competent rock allowed the establishment of an opening closer to the ore contact, and somewhat larger areas were available for the establishment of the plant.

## Design of Hoisting Plant Presents Major Problem

All the surface facilities of the Hogarth underground are incorporated in one building which surrounds the headframe. The building is 160 by 240 ft and is of steel frame and tile construction. The shops, change house, boiler room, compressor room and motor-generator rooms supplying the D. C. power to the hoists are located on the main floor, and the office facilities are situated on the second floor. The building has been designed to give the desired flow of traffic and make allowance for a minimum of congestion.

Considerable thought was given to the method of bringing 1000 tph to the surface. The Errington mine had a 4200-ft underground conveyor to transport the ore from the underground crusher to the loading bins. This system was functioning satisfactorily and served a dual purpose as both a hoisting and haulage agent. The location was ideal with a minimum of switch backs in the system, permitted by established surface facilities well back on the hanging wall. However, at the Hogarth mine, conditions were different. The elevation between the first production level and surface was greater and the shaft was to be collared closer to the ore contact. This would have resulted in several switch backs, should such a system be adopted, and any advantages would disappear quickly. Nevertheless, the conveyor system at the Errington was re-calculated in an application at the Hogarth and both the advantages and disadvantages were established. Finally it was decided to go back to skip hoisting for this installation, with a hoisting plant designed for an ultimate depth of 2,000 ft. A production of 1000 tph by hoisting from this depth with reasonable speeds and cycle, indicated that a skip would be required having a capacity of 20 long tons or 22 short tons.

The design of a hoisting plant capable of handling skips of this size presented a major problem. A detailed study was made of both drum and friction types of hoists. The conventional drum type hoist would have had to be 16 ft in diameter and would have necessitated a considerable capital expenditure for surface facilities such as hoist house, headframe, etc. The friction hoist seemed to offer several advantages, but the unknown quantities at the time of the study made the friction hoist somewhat of a departure from conventional thinking. The general engineering department presented complete designs of the two systems, including the necessary headframe and other surface structures in an effort to isolate both the advantages and disadvantages of each. This study indicated a considerable economic advantage in the installation of the friction type system, and the operating characteristics of the hoists seemed to offer considerable advantages in the particular case being studied.

Following this investigation, a contract was signed for the delivery of three friction type hoists, each being independently counterweighted and having automatic push button controls and direct-current drives. The two skip hoists are 11 ft in diameter and are driven by two 1250 hp, 600-volt, shunt-wound dc motors. The cage hoist is 100 in. in diameter and is driven by an 800- hp, 500 rpm, 600-volt dc motor. All three hoists have four ropes throughout, the skip ropes being 1⅝ in. in diameter and the cage ropes 1¼ in. in diameter. The hoists are to be mounted directly over the shaft opening, and all three hoists will be on the one floor with no deflection sheave being used.

The headframe structure is 60 by 60 ft and rises 108 ft above the collar elevation. The hoist floor is the uppermost, with a brake floor and two electrical floors below this. The structure is an integral part of the service building and is of steel frame construction. Due to the weights envolved, (310 tons of suspended load, 210 tons of hoist and motors), it was found necessary to establish a 12-ft deep truss cell around the shaft below the collar and a reinforced concrete foundation on top of this truss cell to provide sufficient rigidity for mounting the hoists. The dump pockets are located below the collar, permitting the 108-ft headframe which makes a low stable structure.

## Eight-Compartment Shaft Is Built

The shaft is 17 ft 2 in. by 24 ft and consists of eight compartments, (two skip compartments, cage compartment, ladder and pipe compartment, ventilation compartment and three counterweight compartments). Shaft support is 6-in, 20 lb H-beams on eight-foot centers, with 15-in. I-sections for bearers located at 200-ft intervals, as well as each station, and a part bearer at the loading pockets.

The shaft piping consists of a 16-in. pump discharge line, a 10-in. diameter air line, a six-in. diameter water line, and a four-in. diameter drain line.

The floor of the dump pocket is located 72 ft below the collar, and the total excavation for the pocket was approximately 60,000 cu ft. From the dump pocket, both ore and waste are fed out on 42-in. conveyor belts, located on conveyor raises which break through at surface. Materials are fed onto the belts by two pan feeders.

Since one skip will handle ore only, one feeder is non-reversible. The other skip will be handling both ore and development waste and the accompanying feeder is reversible so that it may feed to either the ore or the waste belt. The conveyor raises are driven eight by eight ft on a maximum grade of 16 degrees.

Initially, two level stations are to be cut—the first 940 ft, and the second 1240 ft below surface. All production will come from the first level for several years and the second level will be used as a drainage level. The first level station will contain the main sump and pump room. The pump room is to be equipped with four, five-stage Mather and Platt Plurovane pumps, each capable of pumping 1250 U. S. gpm against a 1180-ft head. Each pump will have independent section and will be powered by a 600-hp motor. The second level station will contain two Byron-Jackson submersible pumps having a combined capacity of 4500 U. S. gpm against a 345-ft head.

The skips will be a bottom dump type of conveyance. They will be loaded by loading pockets based on the same principle, wherein the bottom loading pocket is extended out into the shaft by an air cylinder. The same type of door linkage as used on the skips will be installed on the bottom of the loading pocket. This type of loading was resorted to in an effort to keep shaft spill at an absolute minimum. This is necessary due to the wide range of characteristics in ore material encountered in the operation, for moisture content varies considerably, and the handling characteristics vary directly in proportion to the moisture and silica contents. The action of the swing-out loading pocket and the hoists are interlocked automatically so that no power can be applied to the hoist when the loading pocket is in any position other than fully retracted.

## Overall Plan of Operation Includes Block-Caving

While underground mining equipment has not been finalized, the broad mining picture has received careful study. The most modern mining equipment is currently being used at the Errington mine where methods and time study engineers are engaged in determining the appropriateness and the required modifications for the conditions encountered. Initial development is to be done with conventional drill jumbos, high speed loaders, 10-ton bottom dump cars, and battery locomotives.

Two parallel headings are to be driven out from the station to the underground crusher, approximately 1100 ft from the shaft. One opening (10 by 10 ft) will serve as a service entry for men and materials. The second opening (eight by eight ft) will be a conveyor-way carrying crushed material to the skip loading pockets. All service openings will have 90-lb rail on 36-in. gauge throughout.

Mining is to be by block-caving method, and the equipment to be installed will provide a minimum of handling of the ore material. Main and secondary conveyors will carry the ore from the scram drifts to the underground crushing station. The conveyor openings will be carried at a lower level than the service opening to allow for the development of scrams at the service drift elevation. Scram drifts will be equipped with drag type conveyors. Ore will be removed from the draw points directly to the drag conveyor, transferred to belt conveyors to the crusher and then again by conveyor to the loading pockets. The problem of handling 20,000 tpd from a single level, where the possibility of setting up a complete loop system and conventional rail haulage left much to be desired, necessitated these decisions.

From past experience, considerable ground support will be required and studies are being continued in an effort to obtain the most economic and suitable spacing and weight per foot to be used. Considerable success has been achieved with a German type yielding arch set in weights from 16 to 24 lb per ft in scram drifts. A 15-lb, 6 in. H- beam, three piece set has been found to be practical in areas where ground conditions are not too heavy.

Prior to the commencement of economic development within the ore body, it is necessary to lower the water table below the area to be worked. Therefore, the second level, or drainage level, 300 ft below the first level, will be given priority in the initial development work. A single heading will be taken out to the footwall contact and then drifts will be driven in both directions along the strike of the ore. These drifts will be carried from 50 to 100 ft within the carbonate. Drain holes will be put out into the ore, using four-in. tungsten carbide bits and sectional steel, to remove the water. This lowering of the water table can involve considerable time; however, it is anticipated from the experience gained at the Errington mine, that a successful predetermined drill pattern can be established. It is now known that development in undrained areas, while it can be accomplished, proves to be most time consuming and extremely costly.

Current planning calls for a production of 500,000 tons from the Hogarth underground mine in 1960, followed by a rapid build-up to 2,500,000 tons in 1961. The production objective is 30 tons per manshift—a formidable target. Much remains to be done and the time is short, but, with the co-operation received in the past from men, supervisors and management, that target will be reached.

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## CONTINUOUS MINING PRODUCTIVITY

*(Continued from page 57)*

states. This group includes, in addition to mines with mixed types of loading, all mines using mechanical loading with less than 90 percent of output mechanically loaded. In 1956 approximately 8,000,000 tons of coal was loaded by hand at mines that had not completely converted to mechanical loading. The following equipment was used at mines in this eighth group: Continuous mining machines, 5; mobile loading machines into mine cars, 237; mobile loading machines onto conveyors, 164; mobile loading machines into shuttle cars, 296; Duckbills or other self-loading conveyors, 150; hand-loaded face conveyors, 665; and scraper loaders, 21.

Productivity by states in this group varied from 4.62 tons per man per day in Colorado to 10.81 in Illinois. The average tons per man per day for mines in this group was 7.35, compared with 8.62 for all underground mines. This group of mines produced 51,000,000 net tons in 1956, divided as follows: Mobile loading into mine cars, 10,000,000; mobile loading onto conveyors, 6,000,000; mobile loading into shuttle cars, 21,000,000; Duckbills or other self-loading conveyors, 1,000,000; hand-loaded face conveyors, 5,000,000; hand loaded into mine cars, 8,000,000, and a small tonnage by continuous mining and scraper loaders.

### Over 1/4 of Kentucky's Underground Output Hand Loaded

The group "Hand loading only" is compared with mechanical loading in 1956, by states, in table III. Average productivity by states, at bituminous coal and lignite mines with mechanical loading, varied from 3.95 tons per man per day in Arkansas to 15.84 in Illinois. Mines with 100 percent hand loading had the lowest tons per man per day in Oklahoma—2.20—and the highest in Virginia—7.43. More than 15,000,000 tons of coal was produced in Kentucky in 1956 from mines employing no loading devices.

In addition to the 366,000,000 tons of underground production outlined in this report, there were 127,000,000 tons mined by stripping and 8,000,000 tons by auger mining, with productivity rates of 21.18 and 24.85 tons per man per day, respectively. Total production of bituminous coal and lignite in 1956 was 501,000,000 tons and the average productivity for all mines was 10.28 tons per man per day.

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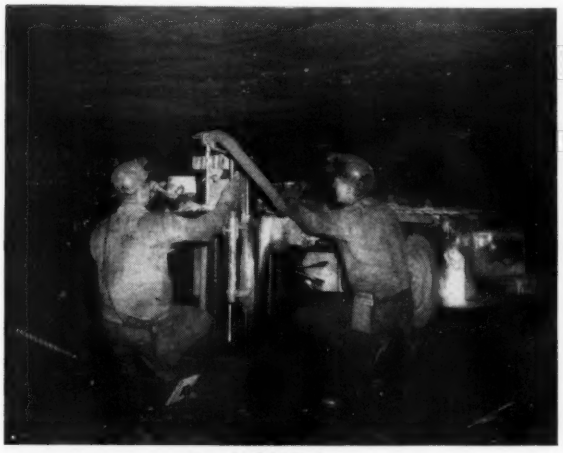

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# Operators' Corner

Figure 2. Storage silos and disengaging box

# Pneumatics Load Alumina Economically*

A COMBINATION of pneumatic conveyors is providing an unusual and highly efficient method for loading alumina on ships at Port Alfred, Que. The system is illustrated schematically in Figure 1.

Alumina is loaded aboard ships at Port Alfred for ocean shipment after having been transported in hopper-bottom railroad cars from the calcining plants of the Aluminum Company of Canada, Ltd., at Arvida, some 21 miles inland. It is then discharged into an activated track hopper (A) located in a car unloading shed.

Alumina is delivered to storage and later loaded aboard ship by pneumatic conveyors in combination with a single belt conveyor. The materials handling system elevates alumina 117 ft vertically (B) from the track hopper through a 10-in. aluminum pipe to a disengaging box (C) situated at the top and between two storage silos (see Figure 2).

Elevating is done at the rate of approximately 125 tph, which requires two 150 hp motors to drive the pump screw and compressor. This system has handled in excess of 200,000 tons, with no indication of major maintenance expense at any point in the system.

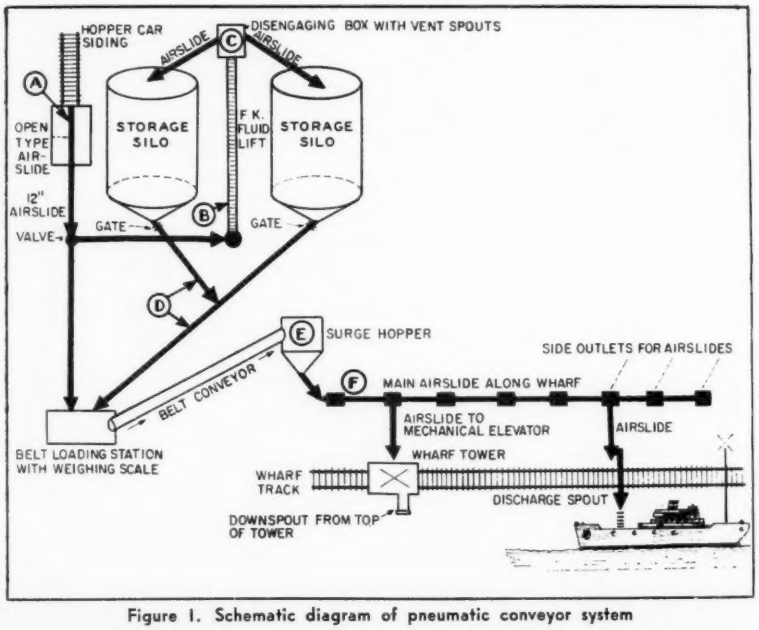


Figure 1. Schematic diagram of pneumatic conveyor system

## How Alumina Is Distributed to Silos

Aluminum pneumatic conveyors receive the alumina from the fluid lift disengaging tank and transport it to the center of the 60-ft storage tanks. The flat-bottom storage silos are equipped with open-type fluidizing conveyors installed in a palmate pattern converging to an opening at the tank wall. Alumina is reclaimed from storage by activating these conveyors, which in turn discharge the alumina through a flow-regulating gate. The alumina is then carried (D) to the belt conveyor.

The unique design of the tubular gallery enclosing the belt conveyor was developed by Alcan engineers. It consists of an 8-ft diam tube of all aluminum construction which was completely fabricated on the ground in two equal sections. These sections were then erected and mounted on three supporting brackets, requiring only a single closure at the mid-point over the intermediate support.

The belt conveyor discharges into a 25-ton surge bin (E), transferring alumina directly through a short cross conveyor to the main 19-in. aluminum conveyor (F) erected on the side of the wharf. This pneumatic conveyor, which is approximately 415 ft long, is installed at an angle of only 1.2° from the horizontal in order to obtain the highest possible elevation at its terminus.

Multiple side discharge outlets corresponding with desirable shiploading positions are provided, each of which is equipped with a quick-coupling attachment and flexible connection.

Materials handling equipment consists of Airslides and Fuller-Kinyon Fluid Lift pumps engineered and manufactured by Fuller Co., Catasauqua, Pa.

* Courtesy of O. S. Tyson and Co., Inc.

# wheels of government

## As Viewed by HARRY L. MOFFETT of the American Mining Congress

CONGRESS has returned to Washington following its ten-day Easter recess and is showing a growing concern over the business recession, but apparently is convinced that an immediate tax reduction measure is not necessary.

Traditionally, the Easter recess marks the halfway point in the session. The remainder of the current session will be steeped in drives to develop palliatives for the economic downspin, with much jockeying for favorable position with the voters on the part of both Congress and the Administration. It will be a period of serious concern for the domestic mining industries. Whether firm action will be taken to adopt sound national mineral policies and legislation to relieve the plight of many branches of mining is still a big question mark. As of this time the situation as to mineral policies might best be described as "much smoke but little fire."

The Congress has a big task ahead of it if it is to adjourn during the summer. Much legislation of a controversial nature, including the Trade Agreements extension measure, unemployment compensation benefits, works projects, foreign aid and the like remain to be acted upon. Each will be the subject of much histrionics colored by political overtones.

### TRADE ACT UNDER FIRE

The Administration's drive to obtain a five-year renewal of the President's authority to negotiate trade agreements is in serious trouble on Capitol Hill. Despite a concerted effort by government officials to whip up enthusiasm for renewal of the Act, protectionist sentiment in Congress grows stronger each day. Several domestic industries, hard hit by imports of cheaply produced foreign commodities, including a number of minerals, have made such strong representations to Congress for tariff relief that the bill now pending before the House Ways and Means Committee may be considerably amended before it reaches the House floor for debate.

Members of Congress from hard hit areas, including mining districts, have either introduced or plan to offer amendments to the bill providing for the imposition of import excise taxes or quotas on a number of commodities entering this country. Other strong moves are under way to provide for Congressional approval or veto of duty charges negotiated under the Trade Agreement Act, or of Tariff Commission findings in "escape clause" or "national security" actions. Many observers freely predict that the pending bill will provide for no more than a three-year extension, with amendments written into it to apply import excise taxes on copper, lead and zinc, and quotas on fluorspar and crude oil and its products.

Hearings on the measure were concluded just prior to the Easter recess, and the House Ways and Means Committee is digesting the testimony with a view towards drafting a revised measure in executive session.

During the course of the hearings Julian D. Conover, executive vice president of the American Mining Congress, urged Congress to reestablish and exercise its authority over tariffs, and to enact specific legislation to solve the critical problems of the mining industry caused by excessive imports. He brought out particularly the need for import taxes for nonferrous metals, to be suspended when prices exceed specified "peril points," and for quotas on imports of residual fuel oil.

### LABOR CURBS QUESTIONABLE

Reliable reports continue to circulate in Washington that action to curb labor union excesses will not be taken by the Congress at this session. These reports hold that many legislators are unwilling to cope with the unsavory situations revealed by the McClellan Committee for fear their seats will be placed in jeopardy at the coming elections.

There are some moves under way in the Senate to obtain passage of labor law revisions. The only measure which has thus far reached the Senate floor is one providing for stronger regulation of health and welfare funds. When it came up for debate Senator Knowland (Rep. Calif.) immediately offered a series of amendments calling for a ban on union agreements to allocate organizing territory, a limit on union officers' terms of four years, and restrictions on the use of trusteeships of local unions. This move caught the Senate leadership by surprise and a Senate Labor Subcommittee, which had previously made it clear that it would not delve into the broad field of recommendations made by the McClellan Committee, announced that it would resume hearings on May 5 on these recommendations and "report a bill to the floor" after some three weeks of hearings.

Immediately after Knowland made his move, Labor Secretary Mitchell, following a White House conference, noted that the Senate debate was go-

### Washington Highlights

**TRADE ACT EXTENSION:** Amendments pushed

**TARIFF COMMISSION:** Recommends lead-zinc relief

**LABOR CURBS:** Doubtful this session

**TVA EXPANSION:** Fought by coal industry

**MINERALS POLICY:** Hearings held

**TAX REDUCTION:** Stirring in Congress

**COAL RESEARCH:** Proposal before House Committee

**OIL IMPORTS:** Program revised

**PRE-MERGER:** Opponents testify

**PRICE DISCRIMINATION:** Bill revision probable

ing far beyond the health and welfare proposal and urged adoption of nine proposals submitted to Congress earlier in the year by the President. These deal with financial reports of unions, election of union officers, and authorization for union members to sue for recovery of funds allegedly mishandled by union officers. The President's proposals also would provide for stricter control over secondary boycotts and "hot cargo" contracts.

Both the Knowland and Administration moves, if brought up on the floor, would result in Senators being forced to go on record on each of the proposals.

Meanwhile the House Committee has remained silent as to the possibility of any consideration of labor law revision.

### LEAD-ZINC RELIEF URGED

On April 24, the U. S. Tariff Commission made public its long awaited report on the "escape clause" investigation conducted as a result of the petition filed with it by the lead and zinc mining industries on September 27, 1957.

The Commissioners were unanimous in their finding that unmanufactured lead and zinc are being imported into the United States in such increased quantities as to cause serious injury to the domestic industries. However, the unanimity ended at this point. Commissioners Brossard, Talbot and Schreiber recommended the application of the maximum permissible rates of duty, as well as quantitative restrictions on imports of unmanufactured lead and zinc. The duties they recommended were as follows: 1.8 cents per pound on the lead content of lead-bearing ores; 2.55 cents per pound on the lead content of lead pigs and bars; 1.8 cents per pound on the zinc content of zinc-bearing ores; and 2.1 cents per pound on the zinc content of zinc blocks, pigs, or slabs.

They also recommended annual quota limitations as follows: 221,700 short tons of unmanufactured lead (lead content), and 325,600 short tons of unmanufactured zinc (zinc content ores and gross weight of imports of unmanufactured zinc in other forms). These quotas would not apply to imports for the national stockpile nor to duty-free imports for export after smelting or refining.

On the other hand, Commissioners Sutton, Jones and Dowling recommended the reimposition of the rates of duty established by the 1930 Tariff Act and opposed any quota restrictions. These rates are as follows; 1.5 cents per pound on lead-bearing ores, 2.125 cents per pound in lead pigs and bars, 1.5 cents per pound on zinc-bearing ores, and 1.75 cents per pound on zinc blocks, pigs or slabs.

The report is now in the hands of the President, who has sixty days in which to take action on it.

### TVA EXPANSION PRESSED

Proponents of public power are seeking to greatly expand the octopus-like tentacles of the Tennessee Valley Authority, through adoption of legislation which would permit the TVA to issue revenue bonds to raise money for power expansion without any guarantee that taxpayers would be relieved of the burden of existing and future subsidies.

The Senate has already approved a bill to greatly expand TVA's power facilities, and the House Public Works Committee has approved a measure granting TVA the right to issue revenue bonds. The latter measure is bottled up in the House Rules Committee and its advocates have been unable to prod it to the floor. An intense drive to accomplish the latter will soon get under way. TVA itself will soon launch a concerted publicity campaign centered on the twenty-fifth anniversary of the power authority, but in reality aimed at forcing the House bill to the floor and obtaining its passage.

Both the House and Senate measure have come under intense fire from the coal industry, coal mine labor, and the electric utilities. Heavy opposition of the coal industry and mine labor stems from the fact that coal buying practices of TVA are driving coal prices to extremely low levels.

### MINERAL HEARINGS HELD

The Senate Interior Committee is undertaking a thorough study of mineral policies with a view towards recommending legislation necessary to maintain a strong mobilization base for the domestic mining industry.

A week of hearings were held late in March, with a parade of industry witnesses urging adoption of policies ranging from continued Government purchase programs to tariff protection. The major share of the recommendations dealt with tariff relief and proposals for tax treatment to encourage mining. These, of course, are not within the jurisdiction of the Senate Interior Committee, but it is expected that the Committee will call attention of the Congress to them and urge the proper Committees to give them favorable consideration.

Lead-off witness at the hearings was Julian Conover, AMC executive vice president, who submitted the strong Declaration of Policy, adopted at the AMC Salt Lake City Convention late last year. He urged continuation of the present Defense Minerals Exploration program without addition of any "pauper's oath" requirements for applicants for Federal loan assistance. In connection with exploration for ore bodies, Conover strongly recommended that present limitations on the tax-deductibility of exploration costs be repealed.

Specifically, the AMC spokesman urged Congress to consider favorably (1) enactment of adequate import taxes, linked to specific "peril points," on minerals such as copper, lead and zinc, (2) adoption of special Government programs for the so-called "strategics" and other minerals produced domestically in amounts meeting only a small percentage of U. S. requirements, (3) review of stockpile goals to determine not only military requirements but with consideration of materials needed to rehabilitate U. S. areas which might suffer atomic attack, (4) directing that stockpiled minerals and metals be upgraded or converted to more readily usable forms, (5) establishment of a free market for gold, (6) requiring the Treasury to purchase all newly mined gold and silver tendered by domestic producers and banning Treasury sales of either metal for industrial use, (7) reduction or elimination of the seigniorage charge on silver, (8) limiting imports of crude and residual oils, (9) initiation of a broad coal research program, and (10) establishment of industry advisory councils to the Department of Interior and the Office of Defense Mobilization.

Conover was followed by a long string of witnesses representing the fluorspar, tungsten, copper, antimony, manganese, chrome, asbestos, mercury and gold mining industries. Their suggested remedies for the plight of the various industries included enactment of excise taxes with appropriate peril points to protect the industry, a combination of tariffs and quotas, distribution of tariff receipts among domestic producers similar to present wool and sugar laws, extension of Government purchasing programs for minerals, upgrading of stockpiled materials, and, in a few cases, continued stockpiling.

The hearings were also highlighted by the appearance of Governor Charles Russell of Nevada, chairman of the Western Governors Conference, who presented the unanimous recommendation of the Western Governors that Congress take specific action with respect to a variety of metals and minerals, to assure that the domestic mining industry retain at least one-half of the domestic market or its present proportion of that market, whichever is higher, through tariffs, excise taxes or quotas, or combinations of them.

The hearings were scheduled to resume on April 28 at which time Secretary of Interior Fred Seaton was slated to testify. Last year he presented some mineral policy recommendations to the Committee, but these were coolly received except for the suggestion that an import excise tax be placed on lead and zinc and adequate peril points be established on the two minerals. There was no indication as to what further suggestions he would make this year, but many observers predicted that there

will be little new in the way of recommendations to the Congress.

While the Administration and its spokesmen continue to maintain a "wait and see" attitude towards reducing taxes this year, many influential members of Congress are champing at the bit to bring out bills before the close of the session which would slash individual income taxes. A number of others on Capitol Hill would seek legislation to encourage investment in production facilities.

After taking soundings in the hustings during the Easter recess, Congressmen returned to Washington with mixed reactions as to tax reduction. Most of them found that the citizenry was more concerned with problems of unemployment and distressed areas than with reducing taxes.

However, the majority party on Capitol Hill is taking a close look at the possibility that tax reduction may be a major shot in the arm to a sinking economy. Even Speaker Sam Rayburn has noted impatience over a decision on taxes and has bluntly called for Congress to make up its mind during May as to what, if any steps, it desires to take in this field. Former President Truman has come out for a $5 billion slash in taxes on lower and middle income groups with the revenue loss to be offset by closing of "tax loopholes." However, Administration spokesmen point out that revenues are declining and a heavy Federal deficit is in the offing. They cite this as a reason for going slow on any moves to cut taxes and increase the Federal debt.

There is considerable feeling in Washington that after all the sparring is over, the eventual outcome will be lower taxes on individual incomes. This month may well spell the answer to the problem. Meanwhile, bills dealing with extension of corporate income tax rates and continuation of existing excise taxes, and with unintended benefits and hardships, languish in Congressional Committees pending any action as to general tax relief. Either of these measures could afford a vehicle for providing for tax slashes.

### COAL RESEARCH HEARINGS

Brief hearings were held before the House Interior Subcommittee on Mines and Mining in April on bills to establish a Coal Research and Development Commission which would establish an over-all research program designed to encourage and stimulate the production and consumption of coal. Representatives of the coal industry, of coal mine labor, and members of Congress from coal-producing areas called for prompt passage of the measure to alleviate distressed conditions in the industry.

Secretary of Interior Fred Seaton, in a written report told the Committee that while his Department was in sympathy with the principles of the legislation, it believed they could be accomplished more effectively through a greater utilization of existing government organizations. His statement was supported by testimony of Bureau of Mines Director Marling J. Ankeny.

Industry witnesses voiced opposition to the Department's suggestion stating that the handling of such a program through existing Government agencies would lack the flexibility needed to accomplish the desired results.

AMC Executive Vice President Julian Conover reiterated the support given the proposed program by witnesses of the American Mining Congress at other hearings held during the past two years. He told the Committee that enactment of the legislation now pending will be an excellent step towards the development of a dynamic coal industry, prepared to meet the heavy demands predicted for coal in the years ahead.

*(Continued on page 75)*


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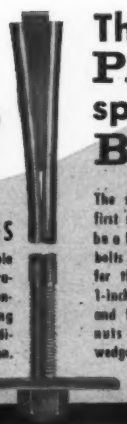

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# personals

**Dr. C. Fred Gurnham,** head of the Department of Chemical Engineering of Michigan State University since 1952, has been named by the American Mining Congress to represent the metal and nonmetallic mining industries on the National Technical Task Committee on Industrial Wastes of the U. S. Public Health Service. He succeeds **Harry Marsh,** Secretary of the Idaho Mining Association, who served as a member of the Committee for several years.

Dr. Gurnham is an expert in the field of industrial waste problems and is author of a book entitled "Principles of Industrial Waste Treatment." In addition to extensive service in the field of education, Dr. Gurnham has had 13 years of full-time experience in industry.

The National Technical Task Committee on Industrial Wastes is an advisory group to the U. S. Public Health Service and represents all major industries in the United States. It conducts studies of industrial waste problems both in industry and in municipalities and makes the results of such studies available to interested managements. It also provides a medium for exchange of information as to water-borne waste problems and abatement efforts of affected industries. Dr. Gurnham is a past vice-chairman and chairman of the Committee.

**J. Matthew Blair** has been promoted to safety director at the Vesta-Shannopin Coal Division of Jones & Laughlin Steel Corp. Blair, who formerly was superintendent of the Division's Vesta No. 5 mine, succeeds **Thomas Park,** who is retiring October 1 following a career of more than 50 years in the coal industry of Pennsylvania, Ohio and West Virginia.

**Donald C. Howe** has been named to superintendent of Vesta No. 5, succeeding Blair. He formerly was mining industrial engineer for the Division.

**Walter Weaver,** California, Pa., formerly assistant mine industrial engineer, succeeds Howe as mine industrial engineer.

Expansion of its Denver district sales staff by the appointment of **Gordon D. Hohler,** former Resurrection Mining Co. office supervisor and purchasing agent, has been announced by Atlas Copco Pacific, Inc.

Following the recent series of promotions in the Coal Division of U. S. Steel Corp., the following changes in personnel have been announced.

**C. W. Connor, Jr.,** has succeeded **Woods G. Talman** as general superintendent of coal operations in the Gary, W. Va. district. **P. E. Watson** succeeds Connor as assistant general superintendent.

C. W. Connor

J. L. Schroeder

J. E. Caffrey

**J. L. Schroeder** has been named acting general superintendent of coal operations in the Lynch district of Eastern Kentucky. **John E. Caffrey** succeeds Schroeder as chief engineer of the Gary district.

**William E. Bertholf,** formerly of Crystal Falls, Mich., is now located at Socorro, N. M., with title of economic geologist for the New Mexico Bureau of Mines, a division of the New Mexico Institute of Mining and Technology.

The newly organized Wycoal Co. has elected **Ray S. Harkins** as president. Harkins has been executive vice-president of Nugget Coal and Timber Co., a subsidiary of the M. A. Hanna Co.

A minerals industry design and construction specialist, **J. Frank Henderson,** has joined Kaiser Engineers as a development engineer in the minerals division. In his new position he will be responsible for development of new clients for the company in both the metallic and nonmetallic minerals fields throughout the United States and Canada.

North American Coal Corp. recently announced that **William A. Barringer,** formerly general sales manager of the Island Creek Coal Sales Co., Huntington, W. Va., has joined the firm as vice-president of sales. He will be in charge of general coal and industrial stores division's sales.

**Frank Whitaker,** former sales vice-president, is now senior vice-president, and will continue to direct national account sales and supervise activities of the firm's dock subsidiaries.

**H. C. Birkhead** has been appointed general sales manager of Island Creek to succeed Barringer.

The election of **Jervis J. Babb,** board chairman of Lever Brothers, New York City, and **Vernon Taylor, Jr.,** Denver financier, to the board of directors of International Minerals & Chemical Corp. was announced by Louis Ware, IMC president.

Electro Metallurgical Co. recently announced the appointment of **O. G. Stewart** as executive engineer, mining. In his new capacity, Stewart will be responsible for exploration, acquisition and management of all Electromet coal lands, and will serve as mining consultant for operations and materials handling. He has been coal mine engineer at the Alloy, W. Va., plant of Electromet.

**R. L. McDaniel** has been named manager of Texas Gulf Sulphur Co. operations in Galveston, Tex. He replaces **R. D. Keenan,** who retired after 37 years of service with the firm.

Mountain Fuel Supply Co.'s senior geologist, **L. W. Folsom** has been named manager of the company's exploration division, and **W. W. Skeeters,** also senior geologist, has been named chief geologist.

Direction of Mountain Fuel's exploration division formerly was supervised by **M. M. Fidlar,** vice-president, who has been transferred to company headquarters in Salt Lake City as senior vice-president.

**Jack O. Horton,** general manager of Vitro Minerals Corp., has resigned to become a minerals consultant in Salt Lake City.

**F. Stillman Elfred,** senior vice-president and a director of Olin Mathieson Chemical Corp., has been named chairman of Peabody Coal Co. Elfred becomes the first chairman for Peabody since the company completed its consolidation moves in 1955. Merl Kelce, president, continues as the coal firm's chief executive officer.

The well-known explosive expert is retiring from his vice-presidential post at Olin Mathieson, but will continue as a director and consultant.

Oglebay Norton Co. recently announced the appointment of **Henry K. Martin** to the newly created post of director of mineral development. He was formerly superintendent of concentration at the Phelps Dodge Corporation's Copper Queen branch.

**Stuart V. Bradley** has been appointed to the newly-created post of staff assistant to the director of mineral development and **A. Herbert Axelson** has been named manager-mining engineering for U. S. Steel's Oliver Iron Mining Division.

The new safety engineer for Bell & Zoller Coal Co. is **Coy L. South.** South has been with the U. S. Bureau of Mines since 1947, and has been Federal Inspector working out of the Benton, Ill., office for the past nine years.

## — *Obituaries* —

**Harrold L. Gobeille,** vice-president, marine department of The Cleveland-Cliffs Iron Co., died March 31 in Cleveland following a long illness.

Mr. Gobeille was born in Cleveland on November 2, 1894. He attended Cleveland public schools and undertook his first job in the Cleveland office of the American Express Co. He joined Cleveland-Cliffs as an accountant in 1916 and in 1917 became secretary to S. Livingston Mather, then vice-president of the firm. In 927 he entered the marine department of the company as vessel dispatcher and upon the retirement of A. E. R. Schneider in 1945 he advanced to department manager. In 1952 he was elected a vice-president.

Mr. Gobeille served as a director and member of the executive committee of the Lake Carriers' Association for a number of years, and during World War II was a member of the Defense Transport Administration. Years ago, Cleveland-Cliffs was the first company to build steel vessels for the transportation of iron ore, and in 1951 Mr. Gobeille scored another first for his company by converting a World War II Victory ship into a Great Lakes carrier—the *Cliffs Victory.*

**Charles S. Winner,** 59, superintendent of the Tennessee Coal and Iron Co. died March 1 in Houston, Texas.

**William L. Creeden,** 88, retired mining engineer, died in Butte, February 15. He was born in Boston and graduated from the Massachusetts Institute of Technology. Mr. Creeden came to Butte in 1902 as engineer for F. Augustus Heinze, and was in charge of the Rarus and Corra mines. In 1906 he established his own consulting engineering firm, retiring in 1941.

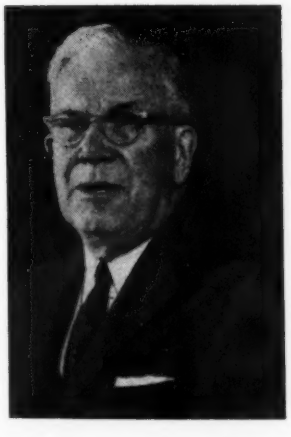
**Stuart Kritzky,** 63, secretary-treasurer of the Nashville Coal Co., died March 28 at his home in Nashville, Tenn.

Mr. Kritzky was born and educated in Louisville. He was formerly associated with the L&N Railroad as an assistant traffic manager. He joined the coal company staff in 1935 and was named secretary-treasurer in 1941.

**Austin L. Hawk** of Raybestos-Manhattan, Inc., died on March 21. He started in the Chicago office of the Manhattan Rubber Division in 1929 as a clerk and progressed to field sales representative, manager of distributor sales, Chicago district manager and manager, central sales region—the position he held at the time of his death.

**Roy H. Glover,** chairman of the board of The Anaconda Company, died the night of March 31 in Washington, D. C., after suffering a heart attack. He was 67 years old. His sudden death came as a deep shock to his host of friends in the copper industry and in the world of business where he played such an active part.

Roy Glover was born in Goldendale, Wash., on July 15, 1890. He graduated from the University of Oregon Law School in 1915 and was admitted to the Oregon bar that year. After practicing in Portland, he moved to Montana and practiced in Great Falls from 1919 to 1936 as a member of the firm of Weir, Clift, Glover and



Bennett. From 1936 to 1943 he was a member of Cooper, Stephenson and Glover.

In 1943 Glover became a member of the legal staff of what was then the Anaconda Copper Mining Co. Two years later he became western general counsel and vice-president, holding those posts until 1951, when he was named general counsel and a director. In 1955 he was elevated to chairman of the board. At the same time he became chairman of Chile Copper Co., Chile Exploration Co., and Andes Copper Mining Co. During his chairmanship of Anaconda production and profits rose to record levels, and assets rose to close to $750,000,000.

For the last year or more the economic situation had hit the copper industry hard along with other enterprises. Mr. Glover, nevertheless, was optimistic, and on March 12 of this year declared that copper prices and production would rise as soon as the current recession ended.

Roy Glover was held in high regard by economic and political leaders throughout the world. In 1955 he was voted "Man of the Year" in Montana and was honored by Chile with Knight Commander, Order of Merit of Bernardo O'Higgins, for his efforts in improving copper production in that country. Another honor bestowed on him ranks in academic importance. In 1956, he became associate member of the Institute of Political and Administrative Sciences of the University of Chile. It was the only time in the history of the university that a foreigner was so honored. He also held an honorary doctor of laws degree from the Montana School of Mines.

Mr. Glover was affiliated with a number of legal and industrial associations including the American and Montana Bar Associations, the American Institute of Mining and Metallurgical Engineers, the National Industrial Conference Board, and the American Mining Congress. He was active in the work of the Mining Congress and rendered outstanding service as a member of its Resolutions Committee.

High officials of Government, of the Congress, of the Republic of Chile, and the State of Montana paid tribute to Mr. Glover and his accomplishments. Senator Mike Mansfield of Montana aptly summed up the feelings of these men when he stated that Roy Glover was "a man who understood the responsibilities of big business and a man who understood the other fellow's point of view."

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# NEWS and views

## Missouri Iron Project Continues

At Pea Ridge, additional drilling during 1957 has indicated resources of iron ore that confirm the estimates on which the project was established. This iron ore will be developed and mined by a new company, Meramec Mining Co., jointly owned by St. Joseph Lead Co. and Bethlehem Steel Corp. With an eventual capacity of 2,000,000 tons of iron ore annually, the project is expected to enter production in the latter part of 1962.

The project will require building 23 miles of track from near Cadet on the main line of the Missouri Pacific to Pea Ridge, and the possible erection of dock facilities for loading barges on the Mississippi River. The town of Sullivan is near enough to the property so that no new townsite need be built. Union Electric Co. has completed two 138,000-volt transmission lines to the plantsite.

## Island Creek Builds Research Laboratory

A coal carbonization research laboratory will be erected by Island Creek Coal Co., adjoining the recently expanded quality control laboratory at Holden, W. Va. The new research facility is expected to be completed this year.

Purpose of the new laboratory is to provide Island Creek with more complete information on the coking characteristics of its coals, both when used alone and when combined with other coals. Data obtained will assist the company's customers to solve problems concerned with selection, blending and preparation of coking coals and the effect of carbonizing conditions on coke quality. It is also expected that the new laboratory will contribute to the technology of carbonization.

## New Jersey Zinc Mine in Production

On January 21 The New Jersey Zinc Company's new mine at Friedensville, Pa., started production. The 2500-ton flotation mill is now making daily shipments of zinc concentrate by truck to the company's smelting operations at Palmerton, Pa.

Friedensville represents another major step in a mine development program designed to make the company largely self sufficient in domestic raw material for many years to come.

## Lamaque Mills Ten Millionth Ton

Lamaque Gold Mines, Quebec's biggest straight gold producer, recently reached another milestone in its 23 years of continuous operation with the milling of its ten millionth ton of ore. The operation to date has produced 2,262,112 ounces of gold. This has been increased to an all-time high during 1957 of a daily average of 2033 tons.

## BCR Grants License to Sell Bin Device

Fairmont Machinery Co. of Fairmont, W. Va., has been granted a license to manufacture and sell the newly-developed BCR Easy-Flo Bin device, according to a recent announcement by Dr. A. A. Potter, president of Bituminous Coal Research, Inc., which developed the unit.

Fairmont will introduce the unit commercially under a non-exclusive license. The Easy-Flo Bin device, which requires no moving parts or vibrating mechanism, was developed to provide reliable flow of coal from bins without arching, ratholing or funneling. Although developed for discharge of coal from bins and silos, the unit can be used for other bulk solids.

## Vermont Copper Operation to Close

The old Elizabeth mine, said to be the nation's oldest copper mine, is being closed down after operating for 165 years. Some 120 miners are employed at the South Strafford, Vt., operation. First worked in 1793, the mine has yielded as much as 300,000 tons of ore per year.

## Coal Firm Changes Name

Stockholders of Lehigh Valley Coal Corp. have changed its name to Lehigh Valley Industries Inc.


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## Glen Alden Plans Merger

The Glen Alden Corp. plans to acquire the business and assets of List Industries Corp. Stockholders of both companies will be asked to approve the proposal when they meet April 11.

In the last few years Glen Alden, which mines anthracite, has diversified by the acquisition of the Mathes Company, Inc., manufacturer of air conditioning equipment and heat pumps, and Ward LaFrance Truck Corp., maker of fire trucks and other automotive units.

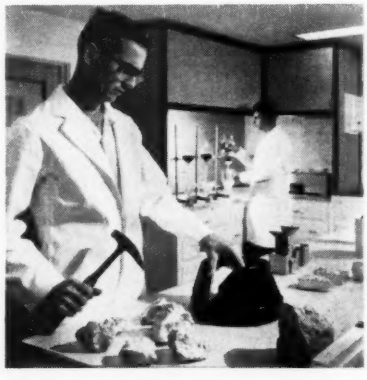
List Industries and its subsidiaries operate the RKO chain of motion picture theatres, do textile finishing, make pistons, operate warehouses and other commercial property, and own an interest in oil and gas properties in Kansas.

## University of Chattanooga Expands Curriculum

The Geology Department of the University of Chattanooga, in Tennessee, headed by Robert L. Wilson, has expanded its curriculum to include courses in petroleum and mining geology. R. Lee-Aston, consulting engineer of Mineral Drilling Service, instructs the added courses. Several field trips have been made to underground operations in conjunction with the mining course.

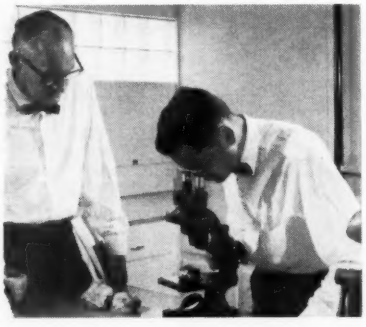
## International Minerals Opens Research Facility

A new mineralogical laboratory has been put into operation by International Minerals & Chemical Corp. at its Experimental Research Station in Mulberry, Fla. Dr. I. M. LeBaron, IMC research vice president, said at the opening that the new research laboratory would allow full-range mineral investigations, from studying composition of new-found ores to checking out the economic soundness of mining and marketing them. This new facility will be used to discover, develop, and keep on tap information management must have for the quick, correct decisions required to keep up with today's opportunities and markets, Dr. LeBaron said.



Equipment for the new laboratory includes facilities for differential thermal analysis, X-ray diffraction, spectography and X-ray spectography, and high-powered microscopic studies.

IMC expects the mineralogical laboratory to make a natural tie-in with the Mining and Exploration Department established a year ago to uncover promising new ores, which can now be quickly analyzed and evaluated at Mulberry. The corporation is a major supplier of industrial minerals, chemicals and plant foods. It is the nation's leading producer of 14 commodities, including phosphate, feldspar, high grade silica sand, potassium sulfate, bentonite, potassium chloride and foundry fire clays.



The Mulberry station has 15 pilot plant and sub-pilot plant facilities, flexible enough to permit duplicating most of the company's commercial production facilities.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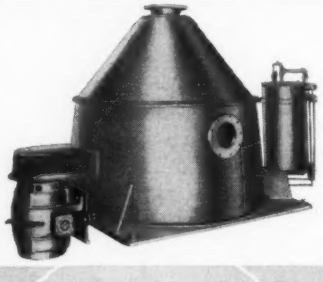

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## Major Coal Producers in 1957

The Pittsburgh Consolidation Coal Co. retained its position as number one producer in the United States with an output of 39,000,000 tons, according to the *Keystone Coal Buyers Manual*. The firm accounted for 7.9 percent of total U. S. production in 1957 as compared to 8.1 percent in 1956. Peabody Coal Co. became the nation's second largest coal digger last year with a production of 22,500,000 tons. U. S. Steel Corp. was third; Island Creek Coal Co. fourth, and Bethlehem Steel Co. fifth, according to the McGraw-Hill Publishing company's magazine.

## Talc Mill to Be Built in Newfoundland

A 100-ton-per-day talc mill is to be constructed at Manuels, Newfoundland, to take the place of the old mill which has been idle for many years. It is to be built and operated by Newfoundland Minerals Ltd., a wholly owned subsidiary of American Encaustic Tiling Co. of Lansdale, Pa. John St. John is the manager.

## West Kentucky Mines Win Fight

Western Kentucky coal interests have won a ten-year fight to have their coal included in shipments made abroad by this country under the foreign-aid program.

Congressman William H. Natcher, Bowling Green, Ky., recently announced that the International Cooperation Administration has ordered a change in coal specifications which previously barred west Kentucky coal from use by Korean railroads. Heretofore, that region has been barred from the foreign-aid program because the specifications called for a coal with a sulphur content no higher than three percent. Western Kentucky coal has a sulphur content of 3.4 percent.

Shipments of U. S. coal to Korea alone this fiscal year will amount to between $8,000,000 and $9,000,000. In addition there are large shipments to other countries.

## U. S. Steel Subsidiary Plans Mammoth Quebec Project

The iron ore mining and milling project being developed by Quebec Cartier Mining Co., wholly-owned subsidiary of U. S. Steel Corp., is being planned as one of the largest operations of its kind. Plans call for the eventual mining of more than 60,000 tons of ore daily, for an annual output of 8,000,000 tons of concentrates.

Included in the plans are a 200-mile private railroad from Shelter Bay on the St. Lawrence River to the sites of the company's ore deposits 200 miles to the north in the Mount Wright and Mount Reid areas; power developments on the Hart-Jaune River; a new town and deep sea docking facilities at Shelter Bay; a new town at the initial mine site near Lac Jeannine, about 15 miles north of the Hart-Jaune River, with a large airstrip to serve it; and the mill, or concentrator, to be located there and designed as one of the largest in existence.

Quebec Cartier, and its predecessor company Cartier Mining Co., have been working in Quebec since 1950. It holds many properties in the Mount Wright and Mount Reid areas. A great deal of exploration has been done, including surface prospecting, geophysical work and diamond drilling, but large areas are still virtually unexplored.

## Pennsylvania Mine to Be Reopened

In order to replenish "dwindling coal stocks," Republic Steel Corp. reopened its Clyde coal mine at Frederickstown, Pa., on April 2. It resumed mining operations on a four-day-week basis, putting about 500 miners back to work. The mine had been closed since the beginning of the year.

## New Technique for Finding Uranium

Mead L. Jensen, assistant professor of geology at Yale University, has reported a new laboratory technique which may provide clues for finding uranium deposits. He said that a hydrogen sulfide gas may indicate the presence of uranium concentrations. If the theory proves true, the present method of prospecting for uranium with a geiger or scintillation counter can be aided by new and efficient laboratory methods. It also indicates that regions rich in oil—a great source of hydrogen sulfide—may contain concentrations of uranium.

## Pitt Consol Opens Testing Lab

Fittsburgh Consolidation Coal Co. recently announced the opening of a Coal and Coke Testing Laboratory in Library, Pa.

Purpose of the laboratory is to provide facilities for a constant check on coking qualities and to make such facilities available to the metallurgical industry for use in testing coals in which they are interested.

The testing program carried on in the laboratory will make possible periodic checks of coking coal blends, as well as to the qualities of individual coals.

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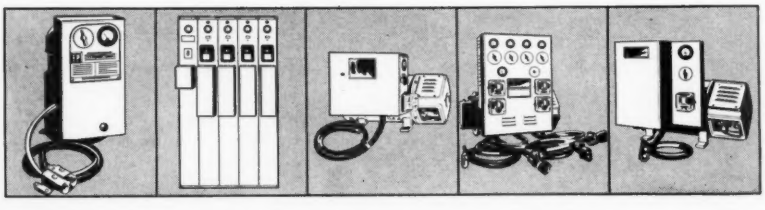

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## Peabody Coal Buys Minority Interests in Two Units

Peabody Coal Co. has bought up minority interests in two of its subsidiaries and sold a 400,000-share block of its common stock to W. G. Duncan Coal Co. of Greenville, Ky.

The 400,000-share block was sold for $10 a share, with proceeds used to retire current indebtedness. At the same time, Peabody purchased from the Kentucky company the remaining 20 percent minority interest in Peabody-Southern Coal Co., and the remaining 50 percent interest in River Queen Coal Co. These two become wholly-owned subsidiaries of Peabody Coal Co.

The interests in Peabody-Southern and River Queen were acquired for 280,000 shares of Peabody common. River Queen operates a new strip coal mine near Central City, Ky., while Peabody-Southern was Peabody's sales subsidiary until it was liquidated March 31. Peabody now handles its own sales.

In addition to the acquisitions and stock sale which were consummated in February, Peabody is entering the final phases of consolidating over 30 subsidiaries into approximately one-third that number.

## National Conference on Clays Scheduled

The Seventh National Clay Conference will be held on October 20 to 23, 1958, in Washington, D. C., at the U. S. National Museum in the Natural History Building of the Smithsonian Institution and will be open to all who have a common interest in clays and clay technology. It is sponsored by the Clay Minerals Committee of the National Research Council and is under the Chairmanship of Dr. H. F. McMurdie of the National Bureau of Standards.

A principal theme for the conference will be "Geology of Clay Deposits." However, papers will also be presented on other phases of the broad subject of "Clays and Clay Minerals." A field excursion is planned for Monday, October 20, to typical clay deposits and soil profiles in northeastern Maryland and northern Delaware. A guided tour to the National Bureau of Standards is being arranged for the afternoon of the 22nd.

Abstracts of proposed papers should be sent by June 1 to the program chairman, John G. Cady, Soil Survey Laboratory, Plant Industry Station, U. S. Department of Agriculture, Beltsville, Md.

## Coal Operators Plant Trees

Strip coal mine operators in Indiana will plant 1,472,000 trees on some 2200 acres in eight counties this year in a land reclamation program, according to the Indiana Coal Association.

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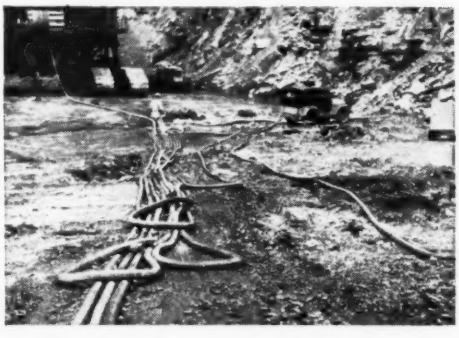

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## Inco Develops New Electrorefining Process

Research scientists and engineers of The International Nickel Co. of Canada, Ltd., have developed a new process for the electrorefining of nickel, according to a recent announcement by Ralph D. Parker, vice-president in charge of Canadian Operations.

A main feature of the process is the direct electrolysis of nickel matte, an artificial sulfide. This contrasts with the usual electrorefining methods in which a metal anode is used. The new Inco process eliminates high-temperature oxidation and reduction operations, with attendant losses of metals and sulphur and selenium. Instead, nickel sulphide of low copper content from the Bessemer converter or other source can be cast directly into sulphide anodes and electrolyzed for the production of high quality nickel. Another feature of the process is that it permits, for the first time in nickel refining, the commercial recovery of elemental sulphur and selenium as valuable by-products, in addi tion to cobalt and precious metals conventionally recovered.

Declaring that the new process is more efficient than the company's present practice, Parker said its development constitutes still another step forward in Inco's program to obtain maximum recovery of useful elements from the ore it mines. International Nickel recovers 14 elements from this ore—nickel, copper, cobalt, platinum, palladium, rhodium, ruthenium, iridium, gold, silver, iron, tellurium, selenium, and sulphur.

The process, for which Canadian and United States patents are pending, is in commercial operation in a section of the company's Port Colborne, Ont., nickel refinery.

## Tennessee Coal Mine to Be Developed

A coal mining operation has moved into the Graves Gap area near Briceville, Tenn., and plans to mine the Windrock seam. Marlow Coal Co. of Kentucky, with 30 years coal mining experience, has leased about 3000 acres from the Coal Creek Mining & Manufacturing Co. The Kentucky firm recently moved bulldozers into the area and began cleaning up operations.

## American Metal Climax Curtails Operation

American Metal Climax, Inc., has announced that the continued low price for base metals has forced deferment of plans of its 75 percent owned subsidiary, Heath Steele Mines Limited, to bring its lead-zinc-copper mine in New Brunswick, Canada, into full operation. The mine and plant with a rated capacity of 45,000 tons of ore per month will continue breaking-in operations at less than one-third of capacity. A small staff and crew will be maintained at the mine primarily to continue development and metallurgical work with a view to having the mine ready for full operation when base metal prices return to normal.

## State Seeks Information on Coal Deposits

U. S. Bureau of Mines and U. S. Geological Survey officials recently promised to help North Carolina determine the economic feasibility of mining bituminous coal deposits in Chatham and Lee Counties. Upon formal request by Governor Luther H. Hodges, federal experts will be sent to the state, not to undertake the technical surveys required, but to advise the state how they might be accomplished and the probable cost.

The coal deposits about which the state desires information are known as the Deep River Coal Field. There has been interest in the possibility of commercial development for a number of years, although various attempts to mine the coal have been unsuccessful. Earlier studies have indicated that the coal is broken by faults and dikes, but the field contains large blocks of good grade bituminous with mineable reserves in excess of 100 million tons.

## Rock Falls Predicted

A technique, which is an extension of the old practice among miners of detecting unstable ground through the popping and cracking of mine rock, has been devised by the U. S. Bureau of Mines. A small instrument called a geophone is used to detect, amplify and record subaudible noises generated by rock under stress. An analysis of these noises allows prediction, within a reasonable accuracy, of when the rock in a given area will fall.

The device has been used successfully to detect loose rock in mine roofs; to determine the stability of underground openings; and to study rock-burst problems which frequently arise in deep mines where tremendous pressures sometimes cause rock to rupture suddenly with explosive force.

## J&L Exercises Option on Ore Property

Jones & Laughlin Steel Corp. of Pittsburgh, Pa., has exercised its 1956 option to lease 5640 acres of iron ore property in the Mt. Wright area of northern Quebec, according to a recent announcement by Avery C. Adams, J&L president. Cleveland Cliffs Iron Co. of Cleveland, Ohio, has joined J&L as a partner in exercising this option.

The property, which is owned by Quebec Cobalt & Exploration, Ltd., is located in Saguenay County on the southern end of the Labrador Trough. J&L holds a 99-year lease on the area, subject to cancellation on six months' notice.

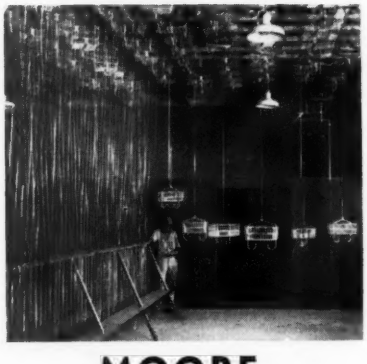
## AEC Releases Uranium Statistics for 1957

Domestic uranium ore reserves were estimated to total 78,000,000 tons on December 13, 1957, according to an Atomic Energy Commission announcement. This compares with 60,000,000 tons estimated at the end of 1956. Ore receipts at all private plants and Government purchase depots in 1957 totalled 3,676,000 dry short tons; ore fed to process totalled 3,575,000 tons with an average of 0.27 percent of $U_3O_8$; and ore stockpiled as of December 31 was 2,033,000 dry tons.

## Coals to Newcastle

The launching of a 15,000-ton motorship recently in Emden, Germany, by August Thyssen-Huette, leading German steelmaker, to transport U. S. coal to its mills in the Ruhr Valley, highlights once more the fact that the once-rich European coal fields can no longer adequately supply their own industries. The move by Thyssen-Huette is also a fundamental step in solving two basic problems which have plagued European industry in recent years—the long delays and high cost of shipping U. S. coal at certain times. Christened "Fritz Thyssen," the ship is expected to make its maiden voyage to Hampton Roads, Va., this April.


**OVERHEAD STORAGE**



**MOORE LOCKERBASKETS**

Overhead lockerbaskets, leaving the floor area unobstructed, cut size of locker room in half, give you 50% saving in locker room cost.

100% exposure of clothing to moving air and light "breathes" away offensive odors, keeps clothes fresher and drier than any other storage system. Ceiling heating units force warm air over clothes, roof exhaust ventilators remove odors and stale air.

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**THE MOORE COMPANY**
Dept. C, 1036 Quarrier St.
CHARLESTON, WEST VIRGINIA

## WHEEL OF GOVERNMENT

*(Continued from page 65)*

To date the committee has not acted on the bill and has given no indication as to when it may take it under consideration.

### OIL IMPORT PROGRAM REVISED

The President has approved a reduction of imports of crude petroleum to 713,000 barrels a day in April, May and June as compared with the 771,400 barrels permitted for importation in the first three months of the year. The new quota amounts to about 12 percent of domestic production.

The Government also took a step designed to put some "teeth" into the voluntary import program and possibly forestall Congressional action to mandatorily limit imports of crude oil and its products. It directed Government agencies to refuse to purchase foreign crude or products refined from such crude from companies which fail to comply with the import restriction program.

Following announcement of the Government's new program Rep. Frank Ikard (Dem., Tex.) introduced a measure to limit imports of crude petroleum and products to their 1954 ratio of domestic consumption. He is expected to push hard for its adoption as an amendment to the Trade Agreements Act. Strong support from the coal industry and from mine labor is behind this move.

### PRE-MERGER NOTIFICATION

The opposition of the American Mining Congress to any legislation requiring premerger notification was presented to the Antitrust and Monopoly Subcommittee of the Senate Judiciary Committee recently by Fred W. Peel of Alvord & Alvord of Washington. The bills would require 60 days prior notification to the Attorney General and the Federal Trade Commission of proposed corporate acquisitions or mergers. They were introduced by Senators Kefauver (Dem., Tenn.) and O'Mahoney (Dem., Wyo.).

Peel, who appeared for Ellsworth C. Alvord, tax counsel of the AMC, who was unable to be present, said, "The American mining industry is completely opposed to the principle of requiring corporations to delay normal business transactions because of a blanket, Government-imposed prior notice law."

Pointing out that such legislation would peculiarily and vitally affect the mining industry, Peel said that the acquisition of assets by a mining company was a day-to-day operation and that such assets were the "stock in trade" of a mining concern. He said it is essential that the mining industry, which is a wasting asset industry, be allowed to replenish its "stock in trade" through acquisition of undeveloped or partially developed mining properties, with a minimum of Government interference. He urged that in the event any "pre-merger" legislation is passed, an exemption be provided for mining companies in the acquisition of such mineral reserves.

As an amendment he urged the Subcommittee to exempt "any acquisition of (i) undeveloped mineral or mining properties or partially developed mineral or mining properties, or interests in such properties, or (ii) stock or other share capital of a corporation, 75 per centum of more of the market value of the assets of which consist of undeveloped mineral or mining properties or partially developed mineral or mining properties, or interests in such properties." This is similar to the amendment which was accepted by the House Judiciary Committee last year upon recommendation of the American Mining Congress.

Representatives of business generally appeared before the Subcommittee in opposition to the adoption of such legislation, whereas Government witnesses testified that such legislation would assist the Department of Justice and other agencies in keeping abreast of mergers for possible violations of the Clayton Act. When the Subcommittee will act on the bill has not been determined.

### PRICE DISCRIMINATION

The Senate Judiciary Committee met again recently without taking any formal action on the so-called price discrimination bill, S. 11, which was introduced last year by Senator Kefauver (Dem., Tenn.). The bill, which would amend the Robinson-Patman Act, would for all intents and purposes preclude a "good faith" defense in price discrimination cases and create great uncertainty as to the legality of freight absorption.

The latest report is that an effort will be made to amend the bill making it applicable only to cases involving food, drugs, cosmetics and auto parts. Although Senator Kefauver is understood to be opposed to such an amendment should it be brought up for a vote.

Similar bills introduced in the House have not been acted on by the Judiciary Committee, and it is doubted if any action will be taken unless Rep. Patman (Dem., Tex.), author of a similar bill, is successful in attempts to get action by discharging the Judiciary Committee from jurisdiction over the bill.

### Stotesbury No. 8 Closes

Eastern Gas and Fuel Associates has closed the Stotesbury No. 8 mine, which employs approximately 300 men. The company action is based on present market conditions. Plans for the future are indefinite.

**NATIONAL MINE SERVICE COMPANY**

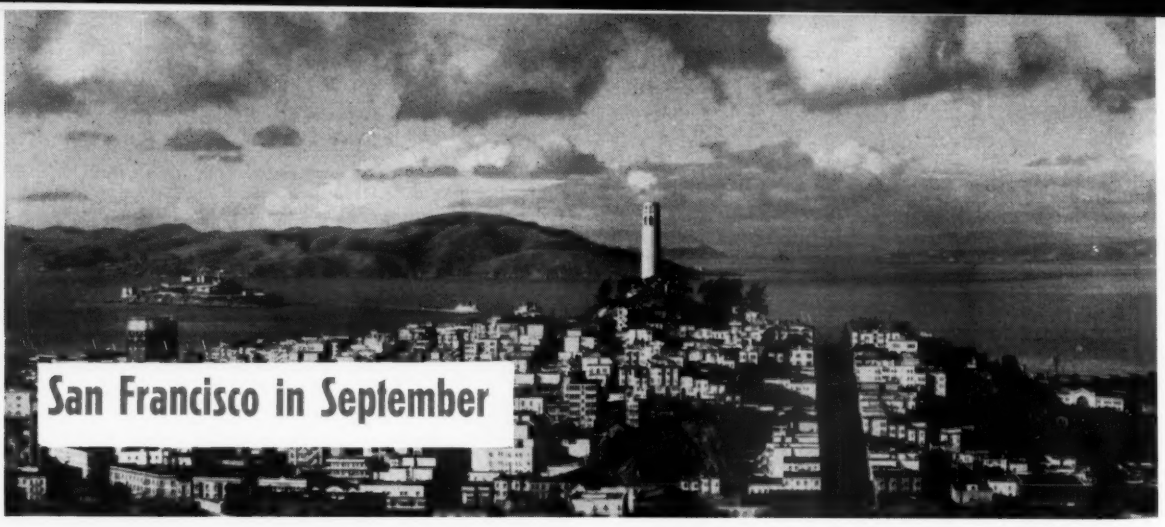
***announces with pleasure***
***the acquisition of***

**GREENSBURG MACHINE COMPANY**

**manufacturers of Greensburg**
**Monitor-Type Storage Battery**
**Mine Locomotives**

**whose operations will be continued**
**and expanded as our GREENSBURG DIVISION**
**at Greensburg, Pennsylvania**

**564 ALCOA BUILDING** — **National Mine Service Company** — **PITTSBURGH 19, PA.**



# San Francisco in September

**MINERS THE COUNTRY OVER ARE MAKING PLANS FOR THE 1958 AMC MINING SHOW**

SEPTEMBER 22 through September 25 are the dates for the Metal Mining-Industrial Minerals Convention and Exposition of the American Mining Congress, to be held at the Civic Auditorium and Civic Center Exhibit Hall in San Francisco. The several committee chairmen under the leadership of John D. Bradley, President of the Bunker Hill Co. and Chairman of the AMC Western Division, have made real progress toward finalizing the arrangements for this outstanding meeting.

Frank Coolbaugh of Climax Molybdenum Co., National Program Chairman, heads a large committee of prominent mining men from all parts of the country representing the entire industry. These men have given serious thought to the program for San Francisco and have submitted their considered suggestions of topics which should be discussed. When the State and District Chairmen meet in San Francisco next month, they will carefully review this cross section of the industry's thinking, and draw up a program designed to throw light on the most important problems in mining today.

Top executives, administrative men, and, in fact, everyone interested in mining will find much of value in the general sessions dealing with pressing economic and legislative matters. Operating men in every phase of mineral production or engineering will profit from the information that will be presented at the various operating sessions. Managers, superintendents, engineers, shift bosses, foremen, electricians, mechanics, safety men, maintenance men, machine operators, and general miners will all be on hand to pick up new ideas and to learn about better ways of doing their jobs when they return to their regular "diggins."

The exposition of mining equipment will be another real highlight of this year's meeting. More than 170 manufacturers and suppliers to the mining industry will display their newest machinery, mining tools, supplies, and services in 110,000 sq ft of exhibit space in the new Civic Center Exhibit Hall, the Civic Auditorium, and the street in front of the Auditorium. Every effort is being made to show the industry the most up-to-date developments for reducing operating costs through improved efficiency.

Outstanding social functions have been scheduled to assure convention visitors an opportunity to get together with old friends and make new ones. The Miners Jamboree, to be held at the historic Palace of Fine Arts on Tuesday night, will feature a western-style dinner, with an abundance of music, dancing and entertainment. The social climax, Thursday night, will be the AMC Dinner Dance, a speechless party, informal as usual, in the delightful setting of the world-famous Garden Court and adjoining ballrooms at the Sheraton-Palace Hotel. Other evenings are left open to allow time for special gatherings and to go out on the town—a painless experience in fascinating San Francisco.

The ladies have planned their own special program which includes a reception and tea at the Alta Mira Hotel in Sausalito, a luncheon trip to Castlewood Country Club in California's wine country, and a glamorous Fashion Luncheon at the stately Fairmont Hotel.

Several industrial field trips have been arranged for Friday following the meeting. And many of the miners will take part in the Salmon Derby, which is being repeated this year by popular demand. Still another group will travel by air to San Simeon to spend a memorable afternoon at this "castle," amid its sumptuous furnishings and old-world art treasures.

Accommodations for everyone will be available at San Francisco's many fine hotels. Make your reservations early through the AMC Housing Bureau, Room 300, 61 Grove St., San Francisco 2, Calif.

# Time is Money - SAVE IT

## with the Lee-Norse BUS & JITNEY

**Take a real good look at these LEE-NORSE "TIME-SAVERS"! Like modern misers they hoard minutes into extra productive hours by cutting portal to portal time—reducing costs—increasing tonnage output.**

### Lee-Norse MINE PORTAL BUS

(Locomotive Type)

This self-propelled Portal Bus for hauling section production crews to and from the face is unique with its split roof construction giving the driver an unimpeded, all directional view . . . the trolley is always within easy reach of the operator. Our standard low and high type Portal Bus operates in the majority of coal mines and will haul from 13 to 20 Men. This Portal Bus is powered with one (1) large motor (15 H. P.) and has two (2) independent braking systems for complete safety — (airplane-type) disc brakes hydraulically operated on each axle and dual mechanical hand operated service brakes on each wheel.

**TIME IS MONEY — SAVE IT with the Lee-Norse Mine Portal Bus!**

### Lee-Norse JITNEY

Wherever they're in use—they're regarded as a time saving asset. Fleet and versatile the Jitney furnishes quick, sure transportation to and from the working face for key personnel, inspectors, engineers, etc. When required the Jitney can be pressed into service as an ambulance and is suitable for pulling fire fighting equipment.

**TIME IS MONEY — SAVE IT with the Lee-Norse Jitney.**

*Write NOW for Literature*

## Lee-Norse Company

CHARLEROI, PA.

**DESIGNERS AND BUILDERS OF THE FAMOUS LEE-NORSE MINER**

# NEWS and views

### Underground Hydraulic Mining

A small, but unique underground operation was described by an official of Black and White Mining Co., which owns the old Brooklyn and D-G properties in the Maxville area of Granite county, Mont.

The company cleaned out and retimbered 1300 ft of old tunnel on the Brooklyn lead-zinc-silver property to expose an old vein of decomposed porphyry dike for hydraulic mining. Two six-in. pipelines were installed, one to furnish high-pressure water from a supply that formerly ran a Pelton wheel on a power plant, and the other to carry washed-down ore by suction and gravity to settling ponds near the mill site about 3000 ft west of the tunnel portal.

The method proved successful and it was found that the overflow of water at the settling ponds had the effect of automatically up-grading the ore about three to one by carrying away waste over the retaining dike. Production last year averaged about 100 tpd in the pond, with three to four men employed. Cost of mining and transporting the ore to the mill was estimated at about $0.50 per ton.

### Phosphate Industry Due for Expansion

Stauffer Chemical Co., and its affiliate San Francisco Chemical Co., announced that vast deposits of phosphate north of Vernal, Utah, will be developed in the near future. Thus, a major industry in the Intermountain West, is due for considerable expansion. The Uintah County lode in Utah, with reserves estimated at 700 million tons, is seen in a regional economic framework as a vast supply base for western and midwestern farm areas—with products of phosphate rock reduction going west to the Pacific Coast and east to the Mississippi River.

The lode is amenable to open pit mining and can become the largest operation of its type in the western United States. It is located along the Vernal-Manila highway, just a few miles from the site of Flaming Gorge dam.

Stauffer is moving into the elemental phosphorous field, it was indicated. A system of selective flotation which will permit a substantial upgrading of the material, has been developed and would involve construction of a mill near Vernal. Initially, developers of the project are looking toward production of about 2000 tons daily. A portion of this would go to the electric furnace for production of elemental phosphorous.

### Haile Mines to Merge With Howe Sound

Merger of the Howe Sound Co. and Haile Mines, Inc., was voted recently by the boards of both concerns, subject to approval of the respective stockholders.

A joint announcement from the two companies said that under the merger plan, Haile holders would receive one share of the combined concern for each two and one-half shares of Haile, and Howe Sound holders would receive one for one. The surviving concern would use the Howe Sound name and would have combined net assets in excess of $28,000,000.

Howe Sound produces cobalt in Idaho and operates lead-zinc mining properties in Chihuahua, Mexico. Haile Mines, producer of tungsten concentrates and metallurgical grade manganese nodules, earlier this year acquired Frank Samuel & Co., ore mineral and chemical importers; Refractories Corp. of America, National Paint and Manganese Co., and a controlling interest in Karl Lieberknecht, Inc., maker of textile machinery.

### Oregon Nickel Deposit Developed

Completion of initial development of a nickel deposit in Josephine County, Oreg., was recently announced by Edward N. White, president of New Delhi Mines, Ltd. of Toronto, Canada.

According to a report submitted by Simard, Knight & Associates, Canadian mine consultants, pitting operations to date have established ore indications of 8,000,000 net tons in one of the three areas being worked, with a potential considerably larger than 52,000,000 gross tons. The nickel content has been calculated to be 1.24 percent.

### Zinc Fertilizer Plant Reopens

Northwest Refining and Chemical Co. is resuming operations at its Spokane Valley plant and will concentrate on chemical fertilizer with a high zinc content. The $275,000 plant has been idle since last spring.

Since its reorganization in November, the company has poured new concrete floors, enclosed the bag-house and installed new fertilizer mixing and pelletizing equipment. The plant expects to get part of its zinc concentrates from Clayton Silver Mines, Clayton, Idaho.

### Anaconda's Clay Pilot Plant Nears Completion

The pilot plant built by the Anaconda Company at Anaconda, Mont., for processing alumina from Latah County clays is nearing completion. Present scheduling indicates that the first of some 7500 tons of the clay material now stockpiled at the plant will be started through the process in the early spring. The plant will utilize the process for extracting alumina from the clays that was developed by Anaconda researchers. Such a process had been sought for more than 25 years by public and private agencies, but it was not until October, 1956, that Anaconda came up with the solution.

The company then obtained options on alumina-rich clays in the Latah county area, and started exploration to determine the extent and richness of the deposits.

### Asarco Signs 99-Year Lease

American Smelting and Refining Co. has signed a 99-year lease and agreement with Jack Waite Mining Co. which supercedes a previous 40-year lease signed in 1934. Asarco has agreed to spend a minimum of $100,000 for additional exploration and development of Jack Waite's properties in the Coeur d'Alene District of Idaho and in Sanders County, Mont. Jack Waite's principal metals are lead, zinc and silver. The new contract is subject to the approval of Jack Waite stockholders.

## Fansteel Opens Plant

Fansteel Metallurgical Corp. opened its $6.5 million tantalum-columbium plant at Muskogee, Okla., recently. Construction of the large plant was started in November 1956.

About 200 persons are employed at the plant and the number may be increased to 500 within four to five years.

The plant is owned by Tantalum Defense Corp., a wholly-owned subsidiary of Fansteel. It will produce tantalum and columbium, to supplement the plant facilities of Fansteel, at North Chicago, Ill. The Muskogee plant's production is expected to increase Fansteel's present tantalum capacity by 50 percent, and its columbium capacity by 150 percent.

Tantalum is used extensively in the manufacture of guided missiles, electronic devices and telephone equipment and in a variety of other ways. Columbium is a sister metal of tantalum which, until recently, had only a limited market. It is used in experimental thermal nuclear reactors. Columbium may also supply a critical need in the manufacture of space vehicles because of its strength and corrosion resistance at high temperatures.

## AIME to Meet in Salt Lake City

The Board of Directors of the American Institute of Mining, Metallurgical, and Petroleum Engineers will meet in Salt Lake City during the Rocky Mountain Minerals Conference, of AIME, to be held there September 17-19, 1958.

## Columbia-Geneva's Progress in West

United States Steel Corporation's Columbia-Geneva Steel Division will put its new coal cleaning plant at Dragerton in east central Utah into operation this spring. Workmen are installing machinery and equipment designed to wash up to 600 tons of coal an hour at the new facility.

The principal building, housing the coal washing equipment, is erected and enclosed. Standing 13 stories high, the steel-clad structure is on a 1400-acre site on the Price River in Carbon County.

Columbia-Geneva also moved another step closer to development of its huge Atlantic City, Wyo., iron ore mining and beneficiation program with the announcement that Bechtel Corp. had been awarded design contracts on the project. A final decision to proceed with the program will not be reached until engineering studies have been completed.

In the meantime, drilling and testing work on the taconite ore body is continuing. Beneficiated iron ore from Atlantic City would supplement production from Iron Mountain area.

*50,000 lb. thrust load torture test for Raynile splice.*

The first Raynile Belt installed by Hewitt-Robins in 1948 is still in service, with a record of extreme ruggedness; exceptional resistance to ripping and to impact; and improved troughing and training.

This is good reason why these Hewitt-Robins conveyor belts have become the FAMOUS NAMES ON THE BIG JOBS EVERYWHERE for handling all kinds of bulk materials:

RAYNILE; for operating tensions of 90 to 130 lbs. per inch per ply.

SUPER RAYNILE; for operating tensions of 150 to 200 lbs. per inch per ply, improved with miracle fabric to do jobs previously thought impossible.

RAYNILE SUPREME; with miracle fiber for tensions over 200 lbs., stronger and more flexible than steel.

Let the many years of Hewitt-Robins experience, engineering, and research in developing the best in conveyor belting benefit your operation. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Connecticut.

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CONVEYOR BELTING AND IDLERS . . . POWER TRANSMISSION DRIVES
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**Rare Earth Properties**

***CONTAINING*** Yttrium group or "heavy" rare earth elements: Xenotime, Gadolinite, Euxenite, Samarskite, or similar types of ores.

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RARE EARTHS AND THORIUM DIVISION

MICHIGAN CHEMICAL CORPORATION

P.O. Box 481, Golden, Colorado • or Saint Louis, Michigan


### THE GOLD BEACH DREDGE

A thousand men to Gold Beach came
To mine the rich black sand;
The yellow aurum lured them on,
Ounce after ounce they panned.

They panned it in their coffee cups,
They dug it with their hand
When, "Gold! Gold! A beach of gold!"
Was heard across the land.

From Minnesota one crew came,
Camped down by Whisky Run.
They brought a dredge like none had seen;
Swore they would mine a ton.

You never saw a rig like that,
With wheels full five feet wide,
And buckets on an endless chain
To drag at lowest tide.

They shipped it in and set it up
And boasted of its price,
"Yes, seven times ten-thousand chips
We paid for this device."

"It's worth that much to mine this beach,
Reclaim its hoard of gold."
So at ebb-tide they took it down
Beside that sea so cold.

Then shooting shafts of steam and smoke,
It roared and clanked in rage.
The buckets broke, the sea came up;
Men ran from that rampage.

It tottered with the pounding surf
And almost killed the crew,
And when the water hit that steam
The boiler nearly blew.

So there it sits, a rusting hulk.
They dragged it up the beach
And left it there to rot away
Beyond the water's reach.

**by Pat Mahon.**

**Panning, sluicing, dredging . . . many ways have been devised over man's lifetime to win minute flakes of precious gold from vast amounts of sand and gravel. Mrs. Mahon poetically describes above one attempt made in 1910 in southwest Oregon. In this instance a dredge, mounted on hollow cylindrical wheels about five feet wide and six feet in diameter, was built to work black sand deposits along the coast between high and low tides.**

## Mercury Deposits Developed

Deposits of cinnabar are being developed in the Green River Canyon, six miles north of Enumclaw, Wash., by the Washington Mining Corp. A 36-ft access tunnel has been completed and work has been planned on a shaft 270 ft deep to the ore body. At the 250-ft mark, 1000-ft long drifts will be drilled in several directions.

The first mine under development is named the Royal Reward. A pilot smelter is in operation to extract the mercury by a distillation process. Early samples indicate that the ore will yield up to 24 lbs of mercury per ton, company officials claim.

The Green River deposits were discovered four years ago by two part-time prospectors, Laurence Berkshire of Palmer, and Ron Ljungdahl of Enumclaw. The men kept their find secret for four years while they bought or leased 2000 acres of land and arranged for financing.

## Uranium Contract Calls for Lower Prices

Vanadium Corporation of America has signed a contract with the Atomic Energy Commission covering the sale of uranium concentrate processed at the company's mill at Durango, Colo. The new contract, effective July 1, 1958, and running to March 31, 1962, calls for generally lower prices than under the present contract.

At Durango, the company is consolidating milling operations heretofore conducted at Naturita, Colo. To accomplish this, milling facilities at Durango are being enlarged. An ore buying station will be maintained at Naturita.

Economies are contemplated from consolidation of the two mills and the initiation of process changes is expected to yield improved recoveries.

## Idaho Phosphate Development Under Way

One of the most unusual phosphate fertilizer plants and mine developments in the United States is more than 25 percent complete at Georgetown Canyon, 17 miles north of Montpelier, Idaho. It is the calcium metaphosphate development of Central Farmers Fertilizer Co., a firm controlled by 14 of the largest farm organizations in the Midwest.

By the end of this year the facilities, estimated to cost between $14,000,000 and $15,000,000 and employing 300 persons, will be producing some 70,000 to 120,000 tons annually of "cal-meta" phosphates and 160,000 to 180,000 tons a year of acidulation grade phosphate rock.

## Lisbon Claims First $10,000 AEC Bonus

Lisbon Uranium Co. of Salt Lake City, Utah, made uranium history April 11 when the richest truckload of uranium ore on record was delivered to the AEC compound at Grand Junction, Colo. Preliminary checks showed the 20-ton load assayed about 22 percent $U_3O_8$, qualifying it for the standing 10-year-old $10,000 government bonus offer never before claimed. The offer expired at midnight the same day, only seven hours after delivery, to make this the only shipment which will ever qualify. Delivery was made by A. P. Kibbe, Lisbon's president.

The company stands to collect nearly $40,000 in addition to the bonus for the premium shipment if the entire load proves out at 20 percent $U_3O_8$.

The ore came from Lisbon's Ike-Nixon property in Utah's Big Indian Mining District near Moab. Lisbon is a subsidiary of Atlas Corp.

## Two Companies Show Interest in Idaho Thorium

Sawyer Petroleum Co., Los Angeles, according to reports, has purchased a large thorite deposit near the Lemhi pass on the Idaho-Montana border. The property was acquired, according to the company president, from Ragand Minerals Co., Dallas, Tex., along with other Ragand assets for $128,000 and 600,000 shares of Sawyer common stock, with a three percent royalty reservation. Sawyer, in developing the deposit, expects to find market outlets for its thorium concentrates in the missiles, aircraft and nuclear reactors fields.

Salmon River Uranium Development, Inc., has purchased a former tungsten concentrator from J. D. Drent at Hall, Mont., and is setting it up on a company property below North Fork in the Lemhi Pass area. Drent will serve as the company's mill superintendent, with the facility to be used for concentrating thorium ores. The plant has a rated input capacity of 100 tpd, and is designed to enable increasing capacity as needed. Operations are expected to begin by mid-summer.

# manufacturers forum

## Kenworth to Purchase Dart Assets

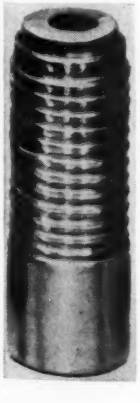
NEGOTIATIONS have been completed by Kenworth Motor Truck Division of Pacific Car & Foundry Co., Seattle, Wash., to purchase substantially all of the assets of the Dart Truck Co. of Kansas City, Mo. Dart Truck Co. is a wholly-owned subsidiary of the Carlisle Corp. of Carlisle, Pa. The purchase was announced jointly by George F. Dixon, Jr., president of Carlisle, and Paul Pigott, president of Pacific Car & Foundry.

Operations of the newly formed KW-Dart Truck Co. will continue in Kansas City and a new manufacturing and administrative facility will be constructed in the immediate future. R. D. O'Brien, vice-president and general manager of Kenworth, is the president of the new company. Carroll J. Warrell, president and general manager of Dart, will continue in that position with the KW-Dart Truck Co.

When the new Kansas City building is completed, production of Kenworth's complete line of rock and ore moving trucks will be moved there from the West Coast.

**Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.**

## Drill Rods

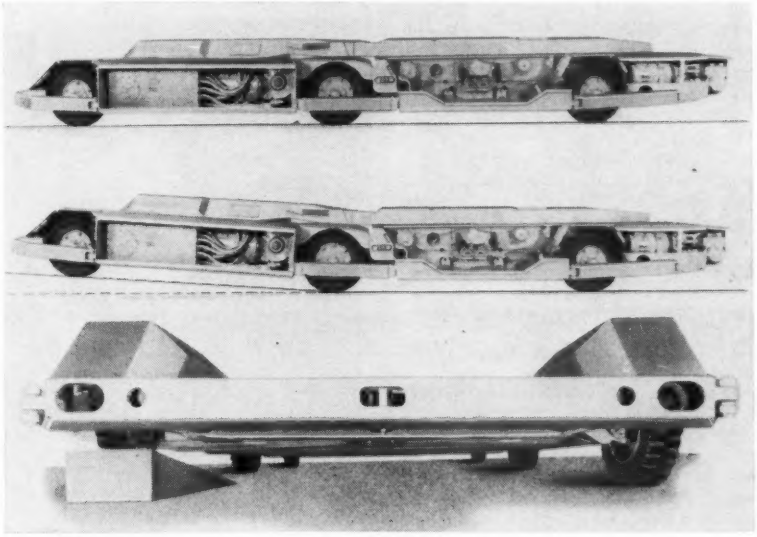


THIS 1½ IN. round hollow extension steel is being supplied by Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill., for use on the crawler-type blast hole drilling machines. It is furnished in either 10 or 20 ft lengths, with K or 600 threads, in carbon steel. Rod couplings and bit adapters also are available for use in long hole drilling. Details are given in Catalog No. 756.

## Low-Seam Shuttle Car

A SIX-WHEELED, low-seam shuttle car has been announced by Joy Manufacturing Co., Oliver Bldg., Pittsburgh 22, Pa. Called the 18-SC, the car is 27 in. high and carries 4½ tons of coal at 3.5 mph. It is said to empty a full load in 27 seconds.

Reason for the car's high capacity lies in its unique six-wheeled design which permits an extra-large fixed height conveyor 6 ft wide and 27 ft long, according to the manufacturer. On four-wheeled shuttle cars, increasing car capacity necessitates increasing the size of the wheel units for proper weight distribution and load bearing. This in turn requires larger wheel wells resulting in less usable payload space. To eliminate this space problem while maintaining good load characteristics, Joy engineers added another wheel to each side of the car, while reducing the over-all size of each wheel unit used.



These additional wheel units are centrally located on each side of the car and are used for the traction drive. Each wheel is driven independently of the other by a ten-hp motor through a speed reducer, chain and sprocket, eliminating transmissions and differentials.

For maximum flexibility under all conditions the 18-SC is hinged the width of the car near the traction wheels. When climbing up and down small rises and depressions the car bends in the middle, keeping the wheels in contact with the ground. This hinged design also permits running the discharge end of the car up a ramp when an elevated discharge is desired.

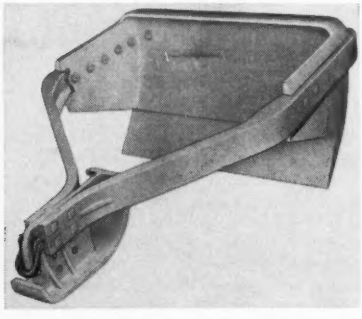
The two wheels in front and those in the rear employ a pivot mounting which enables the car to remain level while negotiating a banked or slanted bottom. This pivot suspension permits the wheels in front to tilt in one direction while the rear wheels tilt in the other. The result, according to Joy engineers, is that the 18-SC can negotiate the roughest bottom quickly and easily without load spillage. The four corner wheels steer the car and are turned hydraulically by twin boosters on each side.

Joy designers claim that the smaller wheel units, the chain and sprocket drive, outboard construction, and one piece unitized frame and body sections will considerably reduce over-all maintenance costs.

Length of the Joy 18-SC is 27 ft; width 11 ft 6 in.; height 27 in. The car has hydraulic disc brakes on each traction speed reducer, a 7½-hp pump motor, and a 7½-hp conveyor motor. Conveyor is reversible. Ground clearance is 5½ in. Total horsepower is 35 hp and weight is approximately 23,000 lb.

## Scraper Line

FOR METAL AND NONMETAL MINING, a new line of TB Series Superior Slushing Scrapers is said to incorporate proven design features which greatly increase digging capacity and load carrying ability. De-



signed and built by the Thompson-Berg Co. of Iron Mountain, Mich., this line of scrapers is offered in sizes ranging from 36 through 84 in. for use with slushers from 10 to 150 hp.

Features claimed include: Contoured, adjustable shoe that easily slides over hard or soft material; interlocking construction that secures the arms to integral side plates; and extra-long, integral side plates that assure full carrying-capacity. The one-piece, replaceable alloy steel blades of self-tightening design can be furnished in various lengths and depths. Two holes for back-pull clevices, located in the outer supporting ribs, permit multiple hook-up for sling type chains. Two holes in the center rib permit single point hook-up for close breast digging when required.

## Industrial Pressure Pipe

PORTABLE ALUMINUM pipe, called APL (Ames Positive-Lock), is available in two, three and four-in. stock diameters, and 20, 30 or 40 ft stock lengths. Weighing as little as 36 lb per 100 running ft, the pipe may be mechanically coupled on the spot in the field. A complete selection of valves, tees, elbows, reducers, and other fittings is available—including the adaptation of APL equipment to existing pipe systems.

The APL coupler is a short section of aluminum or steel pipe, containing the locking device and a Neoprene tri-ring. A length of APL pipe is inserted into each end of the coupler and locked by inserting a stainless steel spring into an opening at the top of the coupler. The spring rides in twin grooves—one on the coupler, one on the pipe—completely encircling the pipe. A second groove in the coupler section holds the tri-ring which presses against both pipe and coupler to make a positive seal.

Two standard stock lines of pipe are available—one with 0.050 in. thick wall for use in systems with maximum pressures up to 600 psi; the other with 0.055 in. wall thickness for use in systems with maximum pressures up to 1000 psi. Calculated bursting pressure on APL pipe ranges from 500 psi to 1700 psi, depending upon the diameter and the wall thickness of the pipe in use.

This pipe is a product of the W. R. Ames Co., Milpitas, Calif.

## Coagulant

AN ORGANIC FLOCCULATING AGENT has exceptional ability to increase the settling and filtration rates of dispersed solids, according to Union Carbide Chemicals Co., Division of Union Carbide Corp. It is a high-molecular-weight grade of Carbide's family of Polyox water-soluble resins and is available in development quantities as white, crystalline granules. The effectiveness of this flocculant over a wide pH range is said to have been demonstrated in a number of systems, including uranium ore slimes, silica suspensions, coal washery and other carbonaceous slurries, and clay suspensions.

Samples and further information on Polyox coagulant are available from Union Carbide Chemicals Co., 30 East 42nd St., New York 17, N. Y.

## Braking Attachment

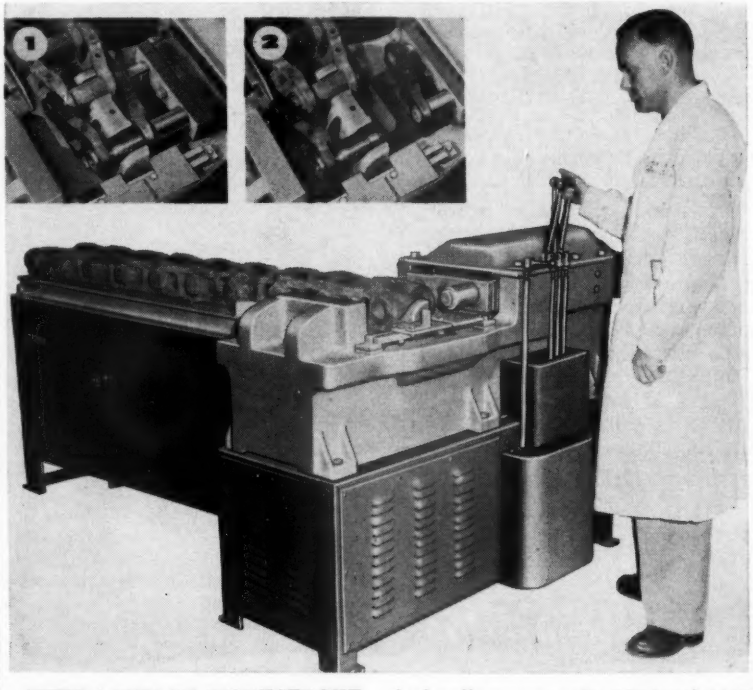
AN INDEPENDENT BRAKE CONTROL GROUP has recently been made available for the Caterpillar DW20 Tractor, according to Caterpillar Tractor Co., Peoria, Ill.

Designed for use with either wagons or scrapers, the attachment allows the operator to engage the brakes of the trailed unit only. It works independently of the standard tractor brakes, and serves as an anti-jacknifing device when operating on hazardous underfooting.

The control group consists of a two-position hand-operated air valve and air circuit, with the hand valve being mounted on the steering column.

The braking attachment is available for field installation, or may be factory-installed on new machines, when specified.

## Track Press




WITH A TWO-IN. WORKSTROKE, the OTC Trackmaster model Y7000 reportedly can handle all makes and sizes of track with grousers removed or left on (two bolts removed). A hydraulic winch (5800-lb line pull) draws the track along a conveyor to a hydraulic-powered indexer, which aligns the track link in the Trackmaster saddle. Then, in one stroke, hydraulic pressure (to 125 tons) eases the pins and bushings out of the sidelink. Trackmaster also has a hydraulic power takeoff (nine gpm at 2000 psi) for operating other presses, cylinders and rams. Standard power unit is a 7½-hp, 220-440 v, 60-cycle, three-phase motor. Complete details may be obtained from Owatonna Tool Co., 653 Cedar St., Owatonna, Minn.

## Density Measurement System

BASED ON THE PRINCIPLES OF GAMMA RAY transmission from a radioisotope, the AccuRay Density System reportedly measures and/or controls fluid density, specific gravity, percent solids or related quantity. The density unit is applicable to liquids, slurries, and flaked, granulated, powdered, or other divided solids. The system makes no physical contact with the flowing material. Measurements are said to be independent of flow rate and pressure.

The measuring head of the AccuRay Density System is constructed of corrosion resistant meehanite castings welded on a section of pipe. Pipe sizes from three to eight in. are standard; other sizes are available on special order.

Manufacturer is Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio.

## Semi-Automatic Transmission

RATED FOR ENGINES UP TO 1550 cu in. displacement producing up to 600 hp, the R-1550 Road Ranger Transmission reportedly was designed specifically for big earth moving and mining equipment. It has nine forward ratios, with direct drive in eighth gear, and two reverse ratios—all controlled with one gear shift lever. Gear shift steps are said to be short and even, averaging 38 percent between ratios. Range shifts are preselected, automatic and synchronized.

For further information write Fuller Manufacturing Co., Transmission Division, Kalamazoo, Mich.

## Air Springs for Vibrating Screens

CONSTRUCTED OF NYLON CORD and high tensile strength, heat-resistant compounds, air springs for Allis-Chalmers vibrating screens are said to provide 98 to 99 percent vibration isolation, depending upon the air pressure used. There are no mechanical parts to lubricate or service, and one size can accommodate a wide range of screen sizes.

The air springs make it possible to adjust to weight differences by altering the pressure, thereby keeping the deck level when handling feed containing large quantities of water. The springs can be inflated from the main air line, portable pressure tank, by pump or air bomb.

Air springs are available on new Allis-Chalmers floor-mounted vibrating screens in sizes 5 to 12 ft and larger. They can also be installed on floor-mounted screens in the field if the screen is already floor-mounted with dual spring arrangements on each corner.

Construction and operating features of the air springs as applied to Allis-Chalmers vibrating screens are described in the company's Bulletin 07B8931, available from Allis-Chalmers, Milwaukee 1, Wis.

## —*Announcements*—

**Hulburt Oil & Grease Co.** recently announced the appointment of **Sheldon Jones** as eastern sales manager.

**Joy Mfg. Co. (Canada) Ltd.,** has announced recent changes in its management.

**James A. Drain,** formerly president, has been elected chairman of the board, and **D. W. M. Ross** has been made president. Drain, also vice president and general manager of the Mining and Construction Division of the parent company, returned to the United States from Canada in 1956.

Ross, prior to this association with Joy, worked in mining fields on several continents. He joined the Joy organization in Canada as a branch manager in Calgary, Alberta, and advanced through positions as general sales manager and vice president and general manager to his present position.

**Howard Goodman** has been elected president and chief executive officer of **Goodman Mfg. Co.** He succeeds **William E. Goodman** who will continue as chairman of the board of directors.

Both men, sons of the founder of the 58-year old mining machinery firm, have been closely identified with the conduct of the business. Since 1939 Howard Goodman has been executive vice president and William Goodman has served as president

**Wilber C. Manning,** assistant director of sales in **Atlas Powder Company's** explosives division has retired under terms of the company's pension plan.

Manning joined Atlas in 1930 when the company acquired the former Peerless Union Explosives Co. of Wilkes-Barre, Pa. Previously he had been an explosives salesman with Hercules Powder Co. and the Grasselli Powder Co., joining Peerless Union in 1923.

In order to provide improved service to its customers, **American Cyanamid Co.** has announced the consolidation of its mining chemicals and explosives sales activities into a new combined unit to be known as the explosives annd mining chemicals department. The new department will become a part of the company's Organic Chemicals Division.

**G. C. Holton** is manager of the department. **J. R. Burkett** and **F. A. Griffin** have been named assistant managers of the department.

## CATALOGS & BULLETINS

ROCK DRILLS. *Atlas Copco Eastern, Inc., 151 Linwood Ave., Paterson, N. J., and Atlas Copco Pacific, Inc., 930 Brittan Ave., San Carlos, Calif.* Three bulletins have been announced by Atlas Copco. Leaflet E-1106 describes the firm's BMK automatic pusher legs for rock drills. The Terrier rock drill, type BBD-12-WH, is discussed in leaflet E-1097. This drill is designed primarily for short-hole drilling, boulder-blasting, bolt hole drilling, etc. Folder E-568 covers carbide inserts now incorporated in Sandvik Coromant integral drill steels.

FLAT TYPE GRAB HOOKS. *Crosby-Laughlin Division, American Hoist & Derrick Co., P. O. Box 570, Fort Wayne, Ind.* Complete details on the division's line of drop forged, grab hooks, including dimensions and capacity, are outlined in Crosby-Laughlin and Lebus Catalog No. 950-2. The hooks are available in three types of material: C-1030 forging steel, with no heat treatment, designed to break BBB chain; C-1030 forging steel, heat treated and designed to break high test chain; Chrome Moly steel, heat treated and designed to break alloy chain.

MAINTENANCE GUIDE. *Advertising Division, Caterpillar Tractor Co., Peoria, Ill.*. Intended to supplement the more detailed information found in Caterpillar "Operation and Maintenance Instructions," this maintenance guide for Caterpillar No. 933, No. 955 and No. 977 Traxcavators has been prepared especially for operators. Ask for form DE 730.

HAULAGE LOCOMOTIVES. *Goodman Manufacturing Co., Halsted St. & 48th Place, Chicago 9, Ill.* Entitled "Goodman High-Speed Mainline Haulage Locomotives," Catalog G-126 describes two trolley locomotives, Type 201 and Type 202. Specifications and operating advantages of the 27-ton and 50-ton units are included.

LARGE INDUCTION MOTORS. *The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.* This 16 page bulletin, No. 1950, presents information on a full line of motors in ratings from 150 to 1250 hp. Cutaway drawings and illustrations show the protection offered by the open drip-proof, splash-proof, enclosed and explosion-proof enclosures in which these motors are built. Also described are a wide range of optional features that are available to match individual job requirements.

CRAWLER TRACTOR. *International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.* The International TD-14 crawler tractor, equipped with the four-in-one Drott Skid Shovel is described in this 16-page booklet, Form CR-635-H. The unit can be operated as a bulldozer, bullclam, skid shovel, or clam shell. Also featured in the booklet are nine attachments that can be used with this unit.

TURNTABLES. *Atlas Car & Mfg. Co., 1140 Ivanhoe Road, Cleveland 10, Ohio.* Six standard types of manually operated ball bearing-mounted turntables are described in Turntable Bulletin No. 1297. These are available in standard diameters of 36 to 96 in. of welded steel construction. Single and cross track units are shown in raised rail and flush rail models. Illustrated are power operated models of up to 16-ft diameter with capacities to 30 tons.

(*Continued on next page*)

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FUEL OIL AND HIGH-RPM DIESEL ENGINES. *Detroit Diesel Engine Div., General Motors Corp., Detroit 28, Mich.* What diesel engine users should know and look for when selecting engine fuel is outlined in this illustrated booklet. Applying to all makes of diesels which operate between 1200 and 3000 rpm, the booklet points out effects of various grades of fuel on diesel engine life and performance. It includes a fuel selection chart to assist engine owners and operators in selecting the type of fuel that will result in the most satisfactory operation of their engines.

SAND AND SLURRY PUMP. *Krogh Pump & Equipment Co., Inc., 515 Harrison St., San Francisco 5, Calif.* Bulletin 601 describes the Krogh Model 600 sand and slurry pump. It gives complete specifications for the pump which is full lined with replaceable and interchangeable hard metal and rubber liners. Cross-sectional view shows construction details and a complete parts list. A dimension diagram is included for layout and design convenience.

PRODUCTION EQUIPMENT FOR MODERN MINING, *International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.* This booklet, Form CR-607-H, shows the application of International crawler tractors, off-highway haulers, power units, scrapers and drilling equipment in all phases of the mining industry.

LITHIUM SOAP BASE LUBRICANT. *The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.* Bulletin 114 covers the use of Molykote, Type BR-2, lubricant packaged in cartridges and applied from a grease gun. Type BR-2 in the grease gun reportedly can be used in extreme pressure industrial applications, in automotive lubrication, and wherever a multi-purpose grease lubricant is required. The lubricant is said to have an operating range of minus 30°F to 250°F and up to 350°F for short periods.

COUPLER. *Jordan Industrial Sales Division, OPW Corp., 6013 Wiehe Road, Cincinnati 13, Ohio.* Catalog F-10-R gives complete information on OPW-Jordan Kamlok Quick Couplers, describing Kamlok features, applications, materials, styles and sizes. It also contains dimensional drawings, pressure-temperature ratings, and useful chemical service recommendation chart. Kamloks are used on hoses, piping and equipment.

TRACTOR. *Construction Machinery Division, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.* Major advances in design of the Allis-Chalmers HD-21 turbocharged diesel powered tractor are described in catalog (MS-1243). Tractor specifications are included.

WELDED STEEL PIPE. *Product Information Service, Armco Drainage & Metal Products, Inc., Middletown, Ohio.* Armco Welded Steel Pipe for industrial uses is described. Diameters range from 6 to 36 in. and wall thicknesses 9/64 to 1/2 in. Applications and advantages are covered. Data on pressure design and dimensions and properties are given as well as information on how to order pipe. Ask for SWP-14457.

INDUSTRIAL pH EQUIPMENT. *Beckman/Process Instruments Division, Fullerton, Calif.* Bulletin 5400 gives detailed descriptions and specifications for all Beckman industrial pH instruments, electrodes and accessories.

CRUSHING AS A COMMON HAZARD TO WIRE ROPE. *Advertising Department, Leschen Wire Rope Division, H. K. Porter Co., Inc., 2727 Hamilton Ave., St. Louis 12, Mo.* Red-Strand Wire Rope Service Bulletin No. 102, covering the subject of crushing as a common hazard to wire rope, describes all of the major causes of crushing, including overloading, quick starts, wrong sheave sizes, and others as well as actual mechanical crushing. The folder provides many suggestions for recognizing this source of wire rope troubles and for lessening or eliminating them altogether.

WOOD TANK REFERENCE AND DATA HANDBOOK. *National Wood Tank Institute, 332 South Michigan Ave., Chicago 4, Ill.* This manual includes such subjects as: The uses of wood tanks; capacities; physical and chemical properties of wood and their relation to expected service of wood tanks. The volume projects the use of wood to cover the most severe conditions found in chemical processing by the use of selected polymer linings.

JET DRILL RIG. *Carpco Manufacturing, Inc., Jacksonville 6, Fla.* Bulletin DRB-101 gives design, construction, photographs and specifications of Jet Drill Rigs. Two models are described. Model DR1500, said to be particularly suited for reconnaissance drilling, is designed for operation on a 1½-ton, 4 by 4 truck with power take-off. Model DR165 is a self-contained skid-mounted unit designed for operating with or without a truck.

ROAD MACHINERY PRODUCTS. *Huber-Warco Co., Department CLF, 202 N. Greenwood St., Marion, Ohio.* This 32 page brochure covers the company's complete line of road machinery products, outlining the features of Huber-Warco motor graders, tandem and three-wheel rollers and the maintainer. Photographs illustrate the inner-working parts of the equipment.

SHAFT MOUNTED DRIVE. *The Falk Corp., Dept. 255, 3001 W. Canal St., Milwaukee 1, Wis.* Bulletin 7100 describes the complete line of Falk all-steel, helical gear, Shaft Mounted Drives for applications in the range from ½ to 50 hp and from 420 to 5 rpm output speed. The brochure includes description of unit design and construction; suggestions on using shaft mounted drives to solve various application problems; information on how to select the proper size and ratio of unit, including the new high-ratio units and the new size No. 315 for higher hp; sheave and belt selections; and data on accessories.

## *Index to Advertisers*


ACF Industries, Inc., 12

Allis-Chalmers Mfg. Co., 5
Engine Material Handling Div.

American Cynamid Co., 36
Explosives Dept.

Anaconda Wire and Cable Co., 18

Bethlehem Steel Co., 19

Bucyrus-Erie Co., 15

Cardox Corp., Inside Back Cover

Centrifugal & Mechanical Industries, Inc., 70

Deister Concentrator Co., The, 71

Denver Equipment Co., Inside Front Cover

DuPont de Nemours & Co., Inc., 11
Explosives Dept.

Electric Steel Foundry Co., 8

Exide Industrial Division, 72
Electric Storage Battery Co.

Euclid Division, 34
General Motors Corp.

Fletcher & Co., J. H., 61

Flexible Steel Lacing Co., 46

Flood City Brass & Electric Co., 14

Gardner-Denver Co., 4

General Cable Corp., 73

Gerow, Theron G., 69

Hendrix Manufacturing Co., Inc., 37

Hewitt-Robins, 79

Heyl & Patterson, Inc., 14

Jeffrey Mfg. Co., 20

Joy Mfg. Co., 38

Lee-Norse Co., 77

LeTourneau-Westinghouse Co., 7, 9

Longyear Co., E. J., 69

Macwhyte Co., 10

Marion Power Shovel Co., 13

Michigan Chemical Corp., 80

Mine Safety Appliance Co., Back Cover

Moore Company, The, 74

Myers-Whaley Co., 68

National Mine Service Co., 16, 75

Ohio Brass Co., 17

Pattin Mfg. Co., 65

Read, Davis, 69

Roeblings Sons, Inc., John A., 33

Standard Oil Co. (Indiana), 50

Timken Roller Bearing Co., 35

United States Rubber Co., 6

United States Steel Corp., 2, 3
American Steel & Wire Div.
Columbia-Geneva Steel Div.
Tennessee Coal & Iron Div.
United States Steel Export Co.

Woomer, J. W. & Associates, 69

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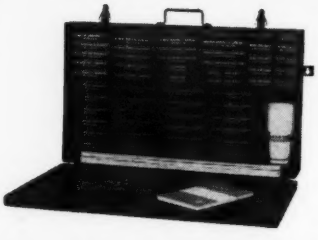

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Contains complete assortment of first aid material and supplies. Ideal for mine hospital or dressing stations. Contents conform to U. S. Bureau of Mines recommendations.

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Contains four 10-ounce Foille Aerosol Sprays, easy-to-use Type D first aid dressings and accessories. Stored in All-Weather steel case. Permits fast effective burn treatment.

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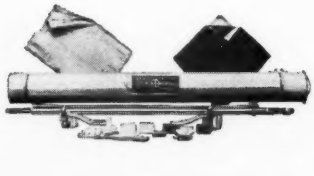
Ideal for storage underground where a compact unit is needed. Contents selected to meet practically every emergency. Includes two first aid kits, blankets, splints, Redi-Heat Blocks, stretchers. Sturdy steel case.



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Complete assortment of first aid dressings and supplies arranged in a strong dust-proof canister. Contains stretcher, blankets, first aid materials, splints. Designed for first aid rooms, dressing stations.

# M-S-A . . . headquarters for First Aid Equipment

Above are a few of the many first aid supplies and treatments available from M-S-A. This material is the result of years of experience in serving the mining industries' requirements.

Our knowledge of emergency needs has developed the design and contents of our first aid line.

You will find complete information in our Mining Catalog—28 pages are devoted to illustrations and detailed information on these and many other first aid supplies. We will be happy to send you a copy upon request.

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